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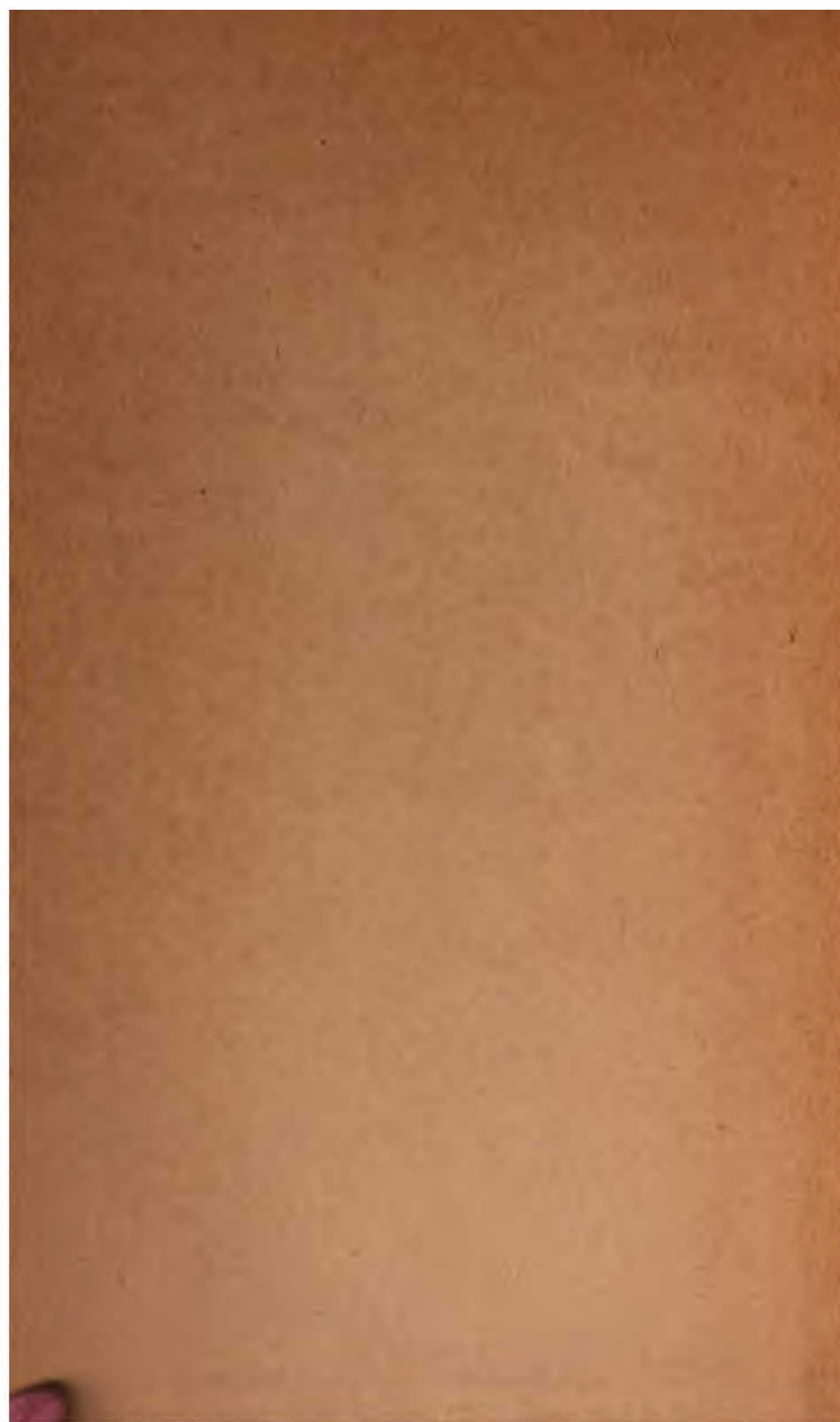
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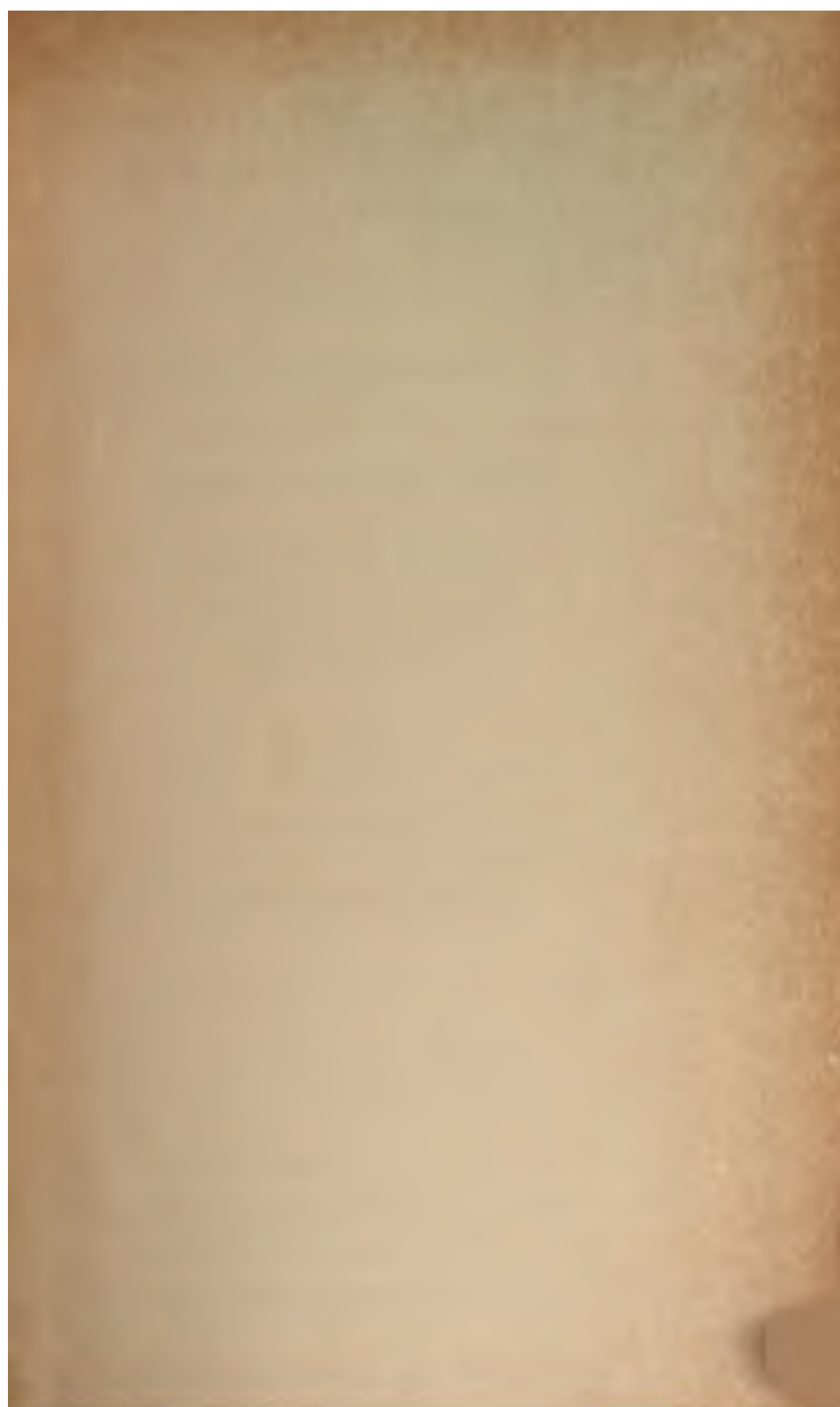




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**Publications of the Red Cross Institute for
Crippled and Disabled Men**

Edited by Douglas C. McMurtrie

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December 23, 1918

Number 4

**Employment Opportunities for
Handicapped Men in the
Coppersmithing Trade**

By Bert J. Morris

Bureau of Vocational Guidance
Division of Education
Harvard University

Prepared by the
Bureau of Vocational Guidance
In cooperation with
Red Cross Institute for Crippled and
Disabled Men, New York

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**Employment Opportunities for
Handicapped Men in the
Coppersmithing Trade**

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Harvard University**



Honins rubber pipe used in shipbuilding with an oil blot

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Foreword

THIS is the first of a series of occupational reports which are being prepared by the Bureau of Vocational Guidance of the Division of Education of Harvard University in cooperation with the Red Cross Institute for Crippled and Disabled Men. The work is being done to assist the Federal Board for Vocational Education which has been empowered by the Smith-Sears Act, approved June 27, 1918, to provide for the rehabilitation and placement of disabled soldiers and sailors.

The aim of the Smith-Sears Act is to provide for the training and equipment of men for occupations in which they can become, as nearly as possible, one hundred per cent. efficient in spite of their handicaps. How to determine the kind of training that will equip men to do this is a difficult problem. Judging from the experience of the Allies who have been working at the problem for more than three years, no adequate solution seems possible without thorough information concerning occupations suitable to disabled men. To make this needed information available, the Bureau of Vocational Guidance of Harvard University has undertaken a comprehensive study of typical forms of industry and business. In carrying on its investigations and in preparing its bulletins the Bureau has two main purposes in mind: First, to place before the returned men descriptions of the varied opportunities for employment open to them, and second, to make available for vocational counselors a fund of information which will assist them in advising the men as to the training courses they should enter and in helping them to choose their new occupations.

The study presented in this report deals with the trade of coppersmithing. The information has been gathered by personal visits to a number of coppersmith shops, by interviews with journeymen, leading men, foremen, employment managers, owners, and general managers; and by correspondence with representatives of numerous other shops that were not reached by personal visits. The manuscript has been read and approved by master coppersmiths, foremen, and employment managers, so that the information here given is authentic.

Different shops have different methods for doing similar processes, hence the descriptions of the processes have been made typical rather than exact accounts of the work in one particular shop. The differences, however, pertain to minor matters and not to fundamentals. The endeavor has been, not to deal exhaustively with technical details, but merely to present the facts in a way that would give one not familiar with the technicalities of the trade a clear understanding of the working conditions, nature of the processes, qualifications of workers, opportunities for employment, and suitability to men with various disabilities.

In dealing with the work in light sheet copper, certain difficulties presented themselves owing to the fact that much of this work is done by sheet metal workers rather than by coppersmiths. Many shops employ sheet metal workers as well as skilled coppersmiths, and in these shops the tendency is to disregard any hard and fast distinction between the work of the two. It is made clear in the text that the real distinction between the coppersmith and the sheet metal worker is in the nature of the article made rather than in the gauge of the copper used. When brazing and forming of copper is to be done, the services of a coppersmith are required whether the article is made of light or of heavy sheet copper. This will explain why

work which is often done by the sheet metal worker is included in this study.

The subject of training workers is treated with some fullness both because of its importance and because of the fact that the fundamental principles apply to other occupations which will be dealt with in later reports.

In conclusion a word should be said concerning the method followed in pointing out the suitability of the work to men with various disabilities. In dealing with work in light sheet copper the several disabilities are related to the work as a whole without making any distinction as to the different processes. This seemed advisable on account of the fact that most of the processes involved in this work are comparatively light. On the other hand, in dealing with the work in heavy sheet copper the different processes are listed, and the suitability of each process to men with various disabilities is discussed. This plan necessarily led to considerable repetition but it has the advantage of presenting more accurate information.

Employment Opportunities for Handicapped Men in the Coppersmithing Trade

THE USES OF COPPER

Early Uses of Copper. Copper was one of the first metals used by man. In the days before Abraham, Tubal-Cain was a master coppersmith and "a forger of every cutting instrument of copper and iron." We are told that Cadmus taught the use of copper to his countrymen. The Homeric Greeks knew the value of the metal and named it after the city of Chalcis. The Incas in Peru used a copper alloy, probably tempered by some lost process, to make the tools with which they cut the granite stones for the construction of their immense aqueducts and temples. In various European lands weapons and tools made of an alloy of copper have been found in the graves of prehistoric peoples. Among the ancient art treasures in the British Museum are various articles made by skilled coppersmiths in the early dawn of civilization. Included among these articles are cooking utensils, lamps, vases, personal adornments, implements of war and of the chase, memorial tablets, and similar articles. The nature, style, and workmanship show that coppersmithing played an important part in the earliest days of human progress.

Present Uses of Sheet Copper. For centuries coppersmithing was devoted almost entirely to the manufacture of the class of articles mentioned in the last section. The secrets of the handicraft were handed down from generation to generation with scrupulous care. When a father taught his son the intricacies of the trade, he charged him

to guard them from the scrutiny of prying eyes. This reluctance to teach the trade to others was due to the fact that coppersmiths looked upon their trade as a private possession to be inherited as other property is inherited.

At the present time sheet copper is used in so many lines of industry that the art of coppersmithing is no longer held as a patrimony by a few. As in other trades, specialization has taken place and men work in groups, each doing only a part of the work required to turn out a finished article. This group method of working has done much to overcome the careful guarding of the intricacies of coppersmithing. Furthermore, most of the light articles which formerly composed the greater part of the coppersmithing output are now manufactured by machinery. The copper-smith has been compelled to pass to heavier work which is not suited to individual shops, but is carried on, for the most part, in large shops employing a number of skilled workers. The feeling of proprietorship of the craft has in this way been broken down.

Today there is scarcely a branch of industry that does not find some use for copper. Contractors use it for skylights, roofing, fire-proof doors, gutters, ornamentation, and other parts in which it is more and more frequently substituted for wood. Plumbers use it where corrosion is to be avoided or where the articles must withstand high pressure. The makers of scientific apparatus use it for mathematical and astronomical instruments of precision. The manufacturers of household utensils and restaurant equipment make extensive use of the metal.

Its most important uses, however, are found in the following fields: First, in the manufacture of high pressure boilers, candy kettles, sugar tanks, vacuum pans, condensers, evaporators, distilling columns, and auxiliary connections used in breweries, distilleries, sugar houses, chemical and dye factories, and munition and high explo-

sive plants; and second, in the manufacture of piping for steam engine and pump connections. The most important part of this latter class of work is in connection with marine engines and the auxiliary equipment of ships.

THE OPPORTUNITIES FOR EMPLOYMENT

The Increasing Demand for Coppersmiths. Skilled coppersmiths are hard to find. Employment managers have recently scouted the country over and say, "There are no coppersmiths to be found." A superintendent of one of the largest shops in the country affirms that five or six positions await every first-class workman. It has been stated on good authority that at least ten more ships would have been launched on the Fourth of July if a sufficient number of skilled men could have been secured to install the copper piping equipment. This fact indicates that the shortage of labor is more acute in copper-smithing than in other shipbuilding trades.

The causes for this shortage are obvious: First, America has been dependent for skilled coppersmiths upon other nations, principally Austria, Russia, and Sweden. Since the war, immigration from these countries has ceased. The supply has not only been cut off, but most of those who were here have been called home for military service. Second, many journeymen and apprentices enlisted for military service before the shipbuilding program was launched. And finally, the great demand for skilled workers in the government shipbuilding plants has drained the coppersmith shops of the country of practically every available man. The situation is serious. Men with an aptitude for metal or mechanical work might well be advised to take up coppersmithing, not only as a patriotic duty, but as a permanent trade.

The Future Development of the Industry. Since the present shortage of workers in this field has been accentuated

by war conditions, it might seem that when the war is over the demand for coppersmiths would cease. A more careful consideration of the facts, however, indicates that the demand will not only not slacken, but is likely to become continually more intense, both in our expanding industries and in ship construction. Should the war cease within a year, the shipbuilding program, even under contracts now let, would continue for some time to come. The money now invested in shipbuilding will not be diverted to other channels until the United States has a merchant marine of vast proportions. Edward N. Hurley, President of the United States Shipping Board, estimates that it will reach twenty-five million tons by 1920. Our share in the commerce of the world after the war will increase rather than decrease. Hence it is reasonable to expect that our merchant marine will continue to grow with the coming years, and the repair work upon it alone will be sufficient to keep the coppersmith trade in a flourishing condition.

In addition to this work, a new industry has sprung up since the beginning of the war—the manufacture of high-grade chemicals and dyestuffs. In 1914 there were in the United States only 112 plants making dyestuffs. There are now over 400 concerns engaged in this industry, and the number is continually increasing. It is often said that “American chemists will never be able to make dyes comparable with the German dyes. When the war is over this new industry will collapse.” By means of recent discoveries, however, American chemists are already in a position to compete favorably with German chemists in this line of work. This country will not, in all probability, be dependent again upon Germany for these necessary products. Furthermore, should the movement for prohibition curtail the manufacture of intoxicating liquors, the plants which are at present used for this purpose.

A Copper Expansion Joint

Such a joint is used on large pipes under high pressure to allow for changes in length due to heat. The workman is hammering the rims of the joint into shape



Drilling holes for attaching fittings to a copper coil for an evaporator



Brazing a Copper Seam. (See page 21)



Operations in the Manufacture of Copper Floats

The worker standing at the lathe is forming flat pieces of sheet copper into the cup-like shapes shown stacked against the wall on his right. The man seated completes the work by soldering the two halves together and attaching the metal lever. This work is suitable for men with an artificial leg, injured hand, hernia, or trunk injuries

would, no doubt, for the most part, turn to the manufacture of chemicals, acids, dye-stuffs, and other articles which would require extensive copper equipment. Hence the fear that the closing of the breweries will menace the coppersmithing trade is not well founded. Therefore with the rapid growth of our merchant marine and the permanent establishment of factories for the making of dye-stuffs, a bright future for the sheet copper trade is assured.

THE NATURE OF THE WORK

Sheet copper work, as it is carried on today, falls naturally into three divisions: First, the manufacture of light articles, such as cooking utensils, fire extinguishers, restaurant equipment, light building material, water-floats, liquid measures, funnels, and many other similar articles. Second, the manufacture of heavy articles, such as vacuum pans, condensers, distilling columns, sugar kettles, chemical vats, acid tanks, dyers' equipment, pressure boilers, expansion joints, tanks, and coils. And third, the manufacture of piping equipment for distilleries, sugar houses, chemical plants, and the main and auxiliary connections of marine engines. A great variety of copper pipes is used for the latter, running in sizes from two to thirty-five inches in diameter.

Light Articles. The manufacture of light articles is done in some shops by coppersmiths and in others by sheet metal workers. Open shops have no hard and fast line which separates the work of the former from that of the latter. Members of sheet metal unions may work on copper of ten gauge and lighter, while coppersmiths may work copper of all gauges. The real distinction between the work of the two trades lies in the art of hammering and brazing copper. These processes require the skill of an experienced coppersmith whether the article is to be made out of light or heavy sheet copper, while inside and outside

work for buildings, cornices, gutters, roofs, doors, furnaces, ventilators, and similar articles are made by sheet metal workers, whether the material used is galvanized iron, zinc, tin, or copper.

Heavy Articles. The manufacture of heavy articles requires extraordinary physical strength and endurance, and more than ordinary mechanical skill. Shops, even when equipped with modern appliances, are not free from dust, gas, and smoke. Working over hot furnaces, in the presence of glaring flames, amidst the continual clang of hammers and the harsh roaring sound of compressed air blasts, taxes one's physical and nervous strength to the utmost. These conditions go naturally with the trade and cannot be eliminated.

Piping Equipment. Copper piping is used extensively in shipbuilding, which requires a large variety of pipes and connections. The work is heavy and presents conditions characteristic of the manufacture of large copper articles. The piping equipment of a ship may be classified under the two following heads: (a) Steam and exhaust piping. (b) Suction and discharge piping.

The steam and exhaust pipe lines connect with the main engines and all auxiliary machinery, such as condensers, main and auxiliary pumps, circulating pumps, fire and bilge pumps, evaporating and distilling plants, sea chests, heating systems, refrigerating plants, and cross connections forming various separate and distinct working units.

Steam pipes are made either of wrought iron, steel or copper. The last is the best for two important reasons: First, it is non-corrosive and therefore withstands exposure to air and sea-water. Second, it is readily bent and formed into shapes necessary to fit all conditions, and is easily formed into T-elbows and S-joints, which are frequently necessary in ship construction. It has, however, the following disadvantages: It costs more than wrought iron

and steel; its tensile strength is less than that of steel; and it often deteriorates in the process of being worked into shape. This last disadvantage is very slight when the work is done properly.

Exhaust pipes are usually made of copper. In some cases brass screwed pipes are used. The main exhaust pipe leads from the main engine directly to the condenser, with branches cross-connecting with auxiliary condensers.

The suction and discharge pipes take care of the water system. They are classed as follows: Sanitary system; feed pipes from tank to boiler; drains from traps to bilges or tanks; fire and bilge suction from sea to discharge on deck; fresh water system from distiller to fresh water tank; circulating water for discharging overboard and cross-connecting with fire and bilge pumps.

SUITABILITY OF THE TRADE TO HANDICAPPED MEN

Work in Light Sheet Copper. This work is well adapted to men with various handicaps for the following reasons:

1. It is light work and does not require unusual physical strength and endurance. Much of it can be done while the worker is seated.
2. A large part of it is now done by machinery. Persons without experience can, within a short time, learn to run different machines, such as drills, presses, spinning lathes, and folding machines.
3. The work may be learned in a comparatively short time without technical training.
4. The products are standard and in constant demand, a fact which assures permanent employment.
5. It is kindred to other sheet metal manufacture so that the worker can turn from one field to another. This assures a wide range in one's choice of employment.
6. It opens the way for men with a mechanical turn of mind to become skilled coppersmiths.

Specific Disabilities

1. *Legs.* An artificial leg would not necessarily lessen one's efficiency, assuming that he had the right attitude of mind and ordinary agility.

2. *Arms.* An artificial arm would be a serious handicap to one, except in case of unusual skill and indomitable will and determination.

3. *Hands.* One hand must be nearly normal, the other usable; the loss of two or three fingers, stiff joints, or even cramped thumb and fingers, would not necessarily incapacitate the worker.

4. *Eyes.* The loss of one eye would not interfere with a worker's efficiency, provided the other eye was normal and the sight strong. The trade requires good eyesight.

5. *Ears.* Deafness would not be a handicap. In fact, many persons who are hard of hearing in ordinary surroundings find they can hear quite well in shops where there is a continual noise.

6. *Neck.* Stiffness of the muscles of the neck and inability to turn the head freely without turning the body may usually be overcome by resolute exercise of the muscle affected.

7. *Head.* Disabilities which might at times produce faintness, lapses of memory, or inability to think connectedly, while not entirely incapacitating one, would be serious handicaps to efficient work.

8. *Trunk Organs.* Much of the work requires one to stand in a stooping position for long periods at a time and to bend the body forward and from side to side frequently. Disabilities of the abdomen, alimentary canal, and kidneys, therefore, which would render stooping and bending difficult, would prevent one from doing efficient work.

9. *Hernia.* Hernia, not of a severe nature and well-controlled, would not incapacitate a worker.

10. *Lung Wounds and Pulmonary Diseases.* Even in well-equipped shops gas and dust cannot be entirely eliminated. Persons with lung wounds and pulmonary diseases should seek employment elsewhere.

Work in Heavy Sheet Copper. Heavy sheet copper work requires unusual physical strength and endurance. Hammers weighing three pounds and more must be used. Planishing, hardening, bending, and brazing copper are processes which tax one's strength severely. The work must be done over furnaces, in high temperatures, in the midst of dust, smoke, and dirt. Handicaps which impair the general health, lessen physical strength, and weaken the powers of endurance would interfere with one's efficiency for work in heavy sheet copper.

To understand the suitability of this work to various disabilities, a thorough comprehension of the different operations involved is imperative. The making of a simple article like a copper roll or shell requires many different and distinct operations which are typical and apply, with natural modifications, to practically all heavy sheet copper work. In a large shop a person would be called upon to perform one, or at most a few, of these processes. Hence a disability that would be a handicap for one process but not for others would not necessarily debar him from the trade. After the processes have been described, the relation of the various disabilities to each of these processes will be pointed out.

Description of Processes

1. *Laying out.* From a blue print the pattern is marked off on the copper sheet.
2. *Cutting.* The metal is cut as marked with a rotary cutting machine.

3. *Beveling edges.* The edges are hammered out to a gradual bevel so as to form a smooth seam when placed together.

4. *Planishing.* The grain of the copper is closed with a heavy hammer and then worked down to a clean, smooth, ~~glazy~~ finish with a muffer over the face of the hammer. A piece of skin parchment drawn tight over the metal may be used instead of the muffer. The function of the muffer or skin parchment is to prevent the impact of the hammer from leaving sharp ridges around the blow.

5. *Folding.* Formerly copper sheets were hammered into the proper shape over a suitable stake or block. Sometimes it was necessary to use a tool known as a shank, which is simply a stake with a cross piece fitted over the top. At the present time most of the work of folding is ~~done~~ by rolling machines, which are made on the principle of a common clothes-wringer.

6. *Clamping.* Slits are cut in one edge of the copper sheet. These slits run obliquely to the edge of the copper, forming clamps, the depth of which varies with the weight of the material.

7. *Dove-tailing edges together.* The straight edge is slipped in between the clamps and spaces of the other edge. The clamps are then hammered down.

8. *Holding seam closed.* After the edges are put together clamps are fastened on so as to hold the seam closed during the process of brazing.

9. *Annealing.* Copper is hardened by hammering or rolling in a heavy press machine and softened by heating. Heating copper to loosen the grain or soften it is called annealing. Annealing furnaces consist of a circular heating chamber opened at both ends so that the copper can be fed at one end and discharged at the other. The heat is applied by means of a compressed air blast through an aperture underneath the circular chamber.

10. *Charging with spelter.* After spelter has been distributed evenly along the seam and heated to the point of melting, which is about 1200° Fahrenheit, borax is thrown in to cause the spelter to flux properly. (Spelter is a brazing solder composed of copper, tin, and zinc. There are three grades, heavy, medium, and light, according to the proportion of the three metals in the alloy. The heavy and medium grades are used for brazing copper; the light grade is used for brazing brass.)

11. *Brazing.* The seam is heated over a clean fire, usually a coke furnace, until the spelter fluxes with the copper. This process requires skill, which can be learned only through experience. On one hand, the seam must be heated sufficiently to cause the copper and spelter to flux well; on the other, if the seam is overheated, the copper will burn and consequently disintegrate. The brazier must be able to tell when the heat is just right by the color of the copper and the action of the spelter. A coppersmith who has been working at the trade for more than a score of years put the matter this way: "You may tell a worker how to braze, and he may understand what you tell him, but this will not enable him to braze properly. He must learn by experience. The skilled brazier cannot say how he acquired the skill; he just picks it up through practice."

12. *Filing and chipping the seam.* After the seam is brazed, the rough parts are chipped off, and the seam is filed smooth.

13. *Scouring and cleaning.* The shell is then immersed in a weak solution of oil of vitriol which removes the borax and most of the smoke and dirt. Upon being removed from the solution, it is scoured clean with water and sand.

14. *Tinning.* The inside is covered with a thin coating of tin. This is done by dipping the copper in molten tin after the outer side has been covered with wet whiting or plumber's soil to prevent the tin from adhering to it.

Another process is sometimes used. It is as follows: The copper is heated to the melting point of tin, cut clean by the application of muriatic acid, and then tin is fused on and spread evenly with a swab dipped in sal ammoniac.

15. *Punching holes for rivets and connections.* Most shops today have machinery for punching holes for rivets, bolts, and connecting pipes.

16. *Soldering the connections.* The castings for the connecting pipes are set in place and soldered by hand.

17. *Riveting.* Two men work together at riveting. One man inserts the rivets, and with a hollow punch draws the copper up around the rivet. The other man with a heavy hammer in both hands drives the rivets down.

18. *Buffing and polishing.* This is done on a lathe with a cloth wheel covered with a composition of emery.

19. *Forming.* Folding a common shell, as noted above, is a simple rolling process usually done by machinery. Frequently, however, workers are called upon to shape copper into complex forms as in making S-bends or dome heads. This is recognized as perhaps the most difficult as well as the most important process in working copper.

The malleability of copper makes it possible to work it into any conceivable shape. It is this quality that enables the worker to form complex and irregular vessels out of the metal without impairing its tensile qualities. To mold copper into these irregular shapes requires high skill and ingenuity. This skill can be attained only by constant practice. Hence it requires a long time, usually three or four years, for an apprentice to become a journeyman.

The tools used in forming copper are numerous. The following are representative: wooden mallets of many different sizes and shapes; hand hammers made in various styles, such as flat-face hammers, round-face hammers,

concave-face hammers, saddle-face hammers, and spring-face hammers; machine hammers; stakes; shanks; blocks; mandrels; and folding machines.

Individual patterns differ so widely that the copper-smith must rely upon his ingenuity to determine what tools are best suited to the particular case. Often improvised appliances are worked out for the occasion. The main thing in forming copper is for the worker to understand how to mold it to fit the particular use for which it is designed.

20. *Bending and fitting pipes.* In marine work pipes must frequently be bent and twisted to fit into the places which they are to occupy. This requires careful work. Bends of all angles, from a gradual curve to a double twist or S-like shape, are often needed. Pipes from two to twelve inches in diameter can be bent without impairing the strength of the pipe. Bends in pipes larger than twelve inches in diameter are usually made in the shop.

Patterns, known as templates, are furnished, showing the exact length of pipe, form of bend, and position of flanges. A piece of piping is cut a few inches longer than the template, and if it is composed of heavy guage copper, it is filled with sand before being bent. Light guage copper pipes are filled with rosin. After being filled with sand the pipe is heated until it takes on a cherry-red color. It is then placed on a bending block—a heavy iron plate three to five inches thick with holes for lugs at regular distances—and bent by hand. In some modern shops the work is done on a bending-roll run by hydraulic power. When pipes are filled with rosin before being bent, they are first annealed, filled with molten rosin, placed in a tank of water to cool, and then bent into shape while cold.

The foreman applies a template made of wrought iron to the pipe as it is being bent, and by this means determines when the proper form is attained. Applying the

template requires good judgment, as the pipe must be bent to the exact form before it has time to cool.

If the pipe is wrinkled in bending, the wrinkles must be carefully hammered out. This is a particular piece of work as the pipe must be kept uniform in size, and the strength of the metal nowhere impaired. In some shops bending machines have been much improved since the war began. One shop has designed a machine which turns out pipes as large as twelve inches in diameter without wrinkling them to any great extent.

After the pipes have been bent to the correct form, the sand or rosin is removed and the pipe washed and scoured. The flanges are then brazed on or fitted on by the method known as the Vanstone joint. This latter method is said to be more economical but, in the opinion of many copper-smiths, it will not be as durable as brazing. It consists in forcing the flange on far enough so that the projecting end of the pipe can be turned over the edge of the flange. This edge is hammered down and holes are punched so that the flange bolts pass through the copper. No brazing is necessary with this joint. After the flanges have been set, the joints are scoured with water and sand, smoothed down with mallet and hammer, and buffed and polished on a lathe. They are then ready to be fitted into place.

Specific Disabilities

1. *Legs.* An artificial leg would not necessarily incapacitate one for any of the processes, provided he had a real liking for the trade and enjoyed robust health.

2. *Arms.* Two good arms are necessary for tinning, brazing, forming, and bending pipes. Men with an artificial arm could help in these and perform nearly all of the other processes. Former metal workers who have lost an arm may become efficient helpers in coppersmithing.

*Soldering Small Copper Pipes
in a Condenser*

The workman holds in his right hand a stick of solder which extends to the bottom of the cylinder where it is heated from the outside by the torch



Deep Sea Diving Helmets

The principal operations consist in shaping the head and shoulder pieces on machines and in brazing on the attachments



A Planishing Machine

The piston resting on the condenser head at P strikes light blows in rapid succession which smooth and harden the copper. (See page 20)



*An automatic rolling machine used for closing the grain
and increasing the tensile strength of copper sheets*
(See page 22)

3. *Hands.* A person who has lost or had one hand seriously injured could do efficient work except on brazing, forming, tinning, and bending and fitting pipes.

4. *Fingers.* The loss of fingers or stiffness of joints does not usually interfere with efficient work in coppersmithing. Persons who have lost three fingers of the right hand, including the forefinger, have become skilled in the trade by painstaking application.

5. *Eyes.* The loss of one eye, provided the sight of the other eye was normal, would not incapacitate one for any of the processes.

6. *Ears.* Deafness would not incapacitate one for any of the processes of the trade.

7. *Neck.* Stiffness of the neck muscles and serious injuries which would interfere with the easy flexing of the neck would be serious handicaps for the processes of charging with spelter, brazing, forming, and bending and fitting pipes.

8. *Head.* Faintness, lapses of memory, lack of muscular coordination, while not incapacitating the worker, would be serious handicaps for the processes of brazing, riveting, tinning, folding, and bending and fitting pipes.

9. *Trunk Organs.* Persons with disabilities of the abdomen, alimentary canal, kidneys, and other trunk organs would not be able to perform the operations of brazing, tinning, riveting, folding, and bending pipes.

10. *Hernia.* Most cases even of severe hernia can be cured by a surgical operation. Men who have been thus cured may enter the trade without serious risk.

11. *Lung Wounds and Lung Diseases.* Physicians have proved that what is known as 'copperman's chest', while a 'pulmonary fibrosis', is due purely to mechanical irritation and not to copper poisoning. However, persons with these disabilities should find employment elsewhere.

12. *Skin.* Certain irritations of the skin might be aggravated by the usual shop conditions. This effect would be due, not to so-called copper poisoning, but to the sharpness of the metal-dust particles. Lead and zinc which are used in copper alloys are extremely poisonous and injurious in the case of a diseased or abraded skin.

13. *Shell Shock.* Persons who have not recovered from shell shock should find employment elsewhere.

THE HEALTH CONDITIONS IN COPPERSMITHING

It is well known that vegetation is very sensitive to certain copper gases and salts—a fact which has led many to believe that copper is injurious to the health of workers. This belief has been strengthened by the fact that men who work continually in copper factories often notice greenish deposits on their teeth and in their gums and a greenish tint to the perspiration.

Careful investigation, however, on the part of physicians, discloses the fact that the diseases known as 'copperman's chest' and 'copper cholic' are not due to copper poisoning. An interview with seventy-five copper smiths in Chicago showed that the men were all uniformly healthy even though some of them had been working at the trade for more than forty years. Zadek, who has made a thorough study of occupational diseases, concludes that there is no evidence for the common belief in copper poisoning. Other men who have made similar investigations say no evidence can be found of copper poisoning among bronze or copper founders. Similar studies among copper miners fail to discover any affliction directly traceable to the poisonous effect of copper.

While physicians do not agree with the idea that copper workers are immune to typhoid fever and other diseases they affirm that copper has 'little significance as an industrial poison'. The conclusion reached by medical experts

is corroborated by the experience of Mr. A. C. Badger of the E. B. Badger & Sons Company of Boston. Mr. Badger is a master coppersmith and has devoted nearly two score years to the work. He writes as follows concerning the relation of coppersmithing to diseases:

In my experience of thirty-eight years in the coppersmith trade I have never known of any case of a man being affected seriously by the fumes of copper or brass. These fumes are caused by the annealing and brazing processes. Many of our men have been in our employ as long as fifty years. We have at the present time several men who have worked with us for almost forty years. Most of the deaths have been from natural causes. Most of the men whom we have lost lived to seventy-five and eighty years of age. If deaths have been laid to work in coppersmith shops from poisonous gases, they generally can be traced to alcoholism.

QUALIFICATIONS OF WORKMEN AND THE TRAINING REQUIRED

The following section lists the most important divisions of the work as found in the average shop:

Foremen. The coppersmith foreman supervises the manufacture and repair work. He should be skilled in all the processes of the trade.

Leading-Men. A leading-man is a first-class coppersmith who serves as an assistant to the foreman. It is his duty to see that work is carefully distributed among the workmen and to have general oversight of apprentices.

First-class Coppersmiths. The first-class coppersmith is a highly trained workman, skilled in working copper into all forms.

Second-class Coppersmiths. The second-class coppersmith is a man who has passed beyond the apprenticeship stage but who has not yet acquired skill in certain operations.

Helpers. Helpers are men without special training who work with the coppersmiths.

Apprentices. An apprentice is one who engages to learn the trade. As a rule he signs an agreement to continue his training for a period of four years.

Physical Qualifications. The work of coppersmithing requires more than ordinary physical strength and endurance. Robust health, good eyesight, and strong physique are qualifications which apply to all classes of workers.

Educational Qualifications

Helpers. No educational qualification is required for a helper. If, however, a man becomes a helper with a view to learning the trade, he should have the general educational qualifications required of apprentices.

Apprentices. Apprentices, as a rule, must be at least sixteen years of age and have completed the first six grades of the common school. The completion of a course in a trade school is desirable. Frequently young men of foreign parentage take up coppersmithing as apprentices before they have learned to read and write the English language. These persons are urged to attend evening or continuation schools.

Second-class Coppersmiths. No educational qualification is required but advancement depends largely upon one's educational equipment, hence a second-class coppersmith, if he expects to advance in the trade, should have the general educational qualifications required of apprentices.

First-class Coppersmiths. In addition to the educational qualifications required of apprentices a first-class coppersmith must be skilled in all of the processes involved in working copper. This skill is attained only through several years of experience. The processes of annealing, hammering, brazing, and forming sheet copper, and bending copper piping can be learned only by long and careful practice in company with trained mechanics. The practical experience of the coppersmith is the most important part of his training.

Foremen. In general the foreman should have a common school education supplemented by a thorough course in a trade school. Whether he has had the advantages of schools or not, he must be qualified in the following lines of work:

- a. Fundamental mechanical methods:
 - Freehand and mechanical drawing.
 - Tracing and reading blue prints.
 - Making rough sketches for shop details.
 - Making and interpreting specifications for all kinds of construction work.
- b. Knowledge of materials:
 - The mechanical action of air on metals and of metals on one another.
 - Solders of all grades together with the chemical action of alloys in solder.
 - Purposes and uses of fluxes.
- c. Shop mathematics:
 - Estimating the amount and cost of materials.
 - The use of computation tables and reference books.
 - Simple algebraic equations and formulae.
 - Determination of areas.
- d. Handling workers:
 - This requires personal qualifications of tact, good judgment, readiness to take the initiative, and ability to comprehend the local labor situation.

TRAINING COPPERSMITHS

The Present Situation. Coppersmithing, being a highly skilled trade, requires careful training on the part of those who become first-class workmen. The most efficient method yet devised for training men in this trade is the old apprenticeship system. With the present high wages for unskilled labor this system, however, is fast becoming inadequate to supply a sufficient number of skilled men to meet the present demands. Young men do not care to

spend four years in learning a trade when they can take up unskilled labor at much higher wages.

It might seem that the numerous trade schools that have been established in the various states during recent years would be able to supply trained workers for this trade. This, however, is not the case. Graduates of trade schools would, for the most part, have to take up coppersmithing as beginners, and the small wages paid at the present time to apprentices are not at all attractive to them. Furthermore, trade schools do not attempt to train men to become skilled mechanics. In reply to an inquiry as to what is being done to train coppersmiths in the State of New York, Mr. L. A. Wilson of the Division of Agricultural and Industrial Education for the State writes as follows:

The evening trade schools have enrolled about 30,000 men and women during the past year. These schools are planned for people who are employed in the trades during the day, and the work in the evening school supplements their daily occupation. No attempt is made in the evening trade schools to train green men for trade work.

The situation is acute, and managers and owners of coppersmith shops recognize that new plans must be adopted for training unskilled men in the trade of coppersmithing.

Shop Schools. The war emergency is causing employers to consider in a new light the question of training men. Formerly the employer held it to be the duty of the worker to educate and train himself. Now many manufacturers see that the training of men is as important a part of any industry as the obtaining of raw materials or the sale of the product. A recent editorial in the *Washington Times* states this point of view very forcibly as follows:

Manufacturers, why not add to your big enterprise a small educational branch and teach men what you want them to know? Provide special instructors. Let a man have a few

hours' training and the rest of the day do manual work, and earn a moderate day's pay while he is learning. When you take in raw material you do not consider that you are wasting time or good nature when you shape it and change it and make it valuable for your use. Why not do with the raw material of unskilled labor what you do with *other* raw material? Manufacturers do not leave to accident or voluntary action their supplies of coal or steel or rubber or other material. Is it not time to stop the haphazard method in regard to labor?

Manufacturers are fast coming to take the same view of the problem of training workers. Many of them have already established successful training departments in connection with their plants. Mr. John C. Spence, superintendent of the training school in the plant of the Norton Grinding Company, Worcester, Massachusetts, speaks of his work as follows:

Our training department is in a gallery of one of our mills. It has its own work room, tool vault, and other facilities separate from the rest of the plant. We have put through this school, since its inception twenty-eight months ago, 270 people. We are now putting them through at the rate of about five per week. We have retained ninety of these in our employ to date. Other Worcester firms have hired 180 away from us. The fact that other people are attempting to hire these men is an indication that the product of our school is at least worth bidding for. The general opinion in the shop is that the school is a good scheme. We pay a beginner according to age, previous experience, and general ability. Boys from sixteen to twenty, without previous experience, get from seventeen to twenty cents per hour. Men who have done such work as driving a grocery team get thirty-five cents per hour. We have found very few who have not earned at least as much as their day work rating and, on the average, the men have earned ten cents per hour over their day work ratings. I believe thoroughly in this work and I believe that the competition of the near future will compel all industries to adopt some such

whence not only for what might be called 'first grade' work, but also to extend the scheme to embrace the training of each grade into still better workmen.

Mr. C. U. Carpenter, Works Manager for the **Recording and Computing Machines Company, Dayton, Ohio**, describes the training department of his company as follows:

When the writer took charge of the works in **January, 1916**, it was the practice to bring the new employees directly into the shop, set them at the machines and have them learn the work at these machines in the shop. They were set to work at either large or small machines, the like of which they had never seen before, and naturally were too nervous to do their best. I therefore started the mechanical training department.

This training department was located in a well lighted room, away from the factory, and placed therein were all of the different types of machines upon which training was necessary. I placed at the head of this school one of my most expert mechanics and operators. The employees were first selected with care by the employment department for the different classes of work that they were supposed to do. The system of teaching was well standardized. The teacher explained the character of the metal and the kind of tools that were used, going over carefully with each individual employee the work that each tool was supposed to do - the machine being operated in order to illustrate each point. We trained them only to become skilled upon one particular job. We sometimes found in the school that the selections for the different operations as made by the employment department were not always the best, and we often shifted employees from one operation to another until the one for which they were particularly suited was found, doing this in the training department so that we would not have this problem to meet in the shop. The length of time required for teaching these operators varied with the class of work but it ranged from three days to ten days. We, who compose this organization, have had very broad experience in many different lines, and we know that the same results can be secured in any branch, whether it is manufacturing of



Man with right hand amputated punching holes in heavy sheet copper

With simple appliances he is able to handle large sheets readily and turns out as much work as any man in the shop. The punching machine is shown at the left; workmen on this operation must know how to adjust it for different kinds of work



Hammering out the wrinkles caused in bending a ten-inch copper pipe. (See page 24)



Three Typical Coppersmithing Operations

The worker at the right is repairing a copper pressure boiler. The one at the left is smoothing out a seam which has been brazed. In the center is shown a shell with a seam (at the bottom) ready for brazing

delicate instruments, shipbuilding, building aeroplanes, or gun production.

In this connection it is interesting to note the stand which the British Government has taken toward Training Departments in factories. At the beginning of the war in 1914 England and France looked to their technical schools for the training of additional mechanics. The supply from that source was so limited that many great producers instituted training departments in their factories. The Ministry of Munitions of Great Britain makes the following statement in regard to this movement:

Every works employing 300 workers or more, with the exception of certain special cases, must set aside a portion of the shop to be organized and maintained as a training shop for improving the skill of unskilled workers. Smaller factories may be exempt if they are able to make suitable arrangements with a technical school in the neighborhood. During the whole of the training period, wherever it may be taken, the employer must continue to pay the workers on the basis of what they earned previously in manufacture.

These instances will serve to show that manufacturers are coming to look upon the training of employees as a part of the legitimate expense of industry. While the instances noted above deal particularly with training a person to do one special operation, it is clear that the same methods may be used—and in fact are at the present time so used in many shops—in training men to become skilled mechanics. No doubt when employers begin to invest more money in the development of skilled workers they will find a solution for many of the present problems connected with the employment of men.

Training for Promotion. It is to be noted, however, that the plant training departments or vestibule schools are not, as they are being conducted today, giving the worker all of the training to which he is entitled. Service depart-

ments are realizing that it is an economical gain for industries to look after the general education of their employees as well as the practical training of them in shop work. The employees who attend continuation or evening schools as a rule recognize more quickly the possibilities for advancement and consequently take more interest in their work. To assist employees in the matter of promotion is as important as to find new employees. An examination of the various kinds of work done in any plant with a view to helping the employment office in selecting and training men is incomplete unless it also classifies the jobs and maps out the natural lines of advancement. The training should therefore be such as to promote one by successive stages to the higher and more desirable positions in the plant. This means that a complete system must provide for the training of foremen as well as of skilled mechanics. Employers everywhere say that it is harder to secure competent foremen than any other kind of worker. This indicates clearly that at the present time there is no adequate means for training them. Foremen are usually responsible for much more than the technical details of construction. Training for foremanship ought to include some of the most important factors involved in dealing with workmen and in the management of a department.

The new view of the relation of industry to the training of its employees was well stated by Mr. F. C. Schwedtman of the National City Bank of New York in an address before the Employment Managers' Association, June 1917. Mr. Schwedtman says:

In our agitation and subsequent mad scramble to apply efficiency to machines and plants, the majority of us have overlooked the factor that is closest to us. Instead of selecting and educating our employees in the pursuits to which they are naturally run, and then handling them through organization and cooperation so as to get the maximum return, we

of us have been too prone to neglect selection and education, and instead have commenced at the end of the progression and have spent our energies in trying to handle them. How much our country loses annually through failure to exercise this proper care in selection and training, and how much energy, time, and money is wasted in allowing men to spend their whole lifetime working at tasks to which they are not by nature adapted, is something which nobody has been able to calculate. Suffice to say that it would run to millions of dollars annually if calculable in money.

There seems no good reason why the kind of educational work described above should not apply to trades like coppersmithing. The details would be different of course. The main thing is for employers to see that it is an economic advantage for them to invest money in the training and education of their employees. Employers and those interested in public education must face the scarcity of skilled workers and take adequate steps to meet the situation. If they need trained workmen, the way to supply the need is to train them.

Mr. Charles B. Rose, Assistant to the Superintendent of Training for the Emergency Fleet Corporation, in reply to an inquiry as to what was being done to train coppersmiths for shipbuilding, says, "There is an acute demand for coppersmiths at the present time and steps are under way for special training centers for this trade." He does not indicate the nature of the training that will be given in these special centers, but it is natural to suppose that the expense will be carried by the Emergency Fleet Corporation. In many respects, this is distinctly a step in the right direction. Where the public schools or other public agencies are able and willing to bear a part of the burden, the best work can probably be done through some cooperative or part-time plan. The Federal Board has recently interpreted the Smith-Hughes Bill in such a way as to

allow the expenditure of federal money for classes conducted within the factory on a part-time basis. In general, the method to be followed in instructing new employees in coppersmithing should be based upon the following steps:

1. An analysis of the operations, somewhat more detailed, but in the main similar to that outlined in the description of processes above.
2. The preparation of practical construction problems illustrating these processes, with the necessary blue prints and instruction sheets to accompany each step.
3. Equipment of a special shop or room for instruction purposes, or where this is not possible, the setting aside of certain machines and benches in each department for learners.

When employers are ready to bear a fair share of the responsibility of training skilled workers, the question of method and detail will be easily solved. Until that time we shall have to depend upon trade schools, technical high schools, and the old apprenticeship system to supply the present demand for coppersmiths.

The Fore River Apprenticeship Plan. The Fore River Plant, one of the largest yards of the Bethlehem Shipbuilding Corporation, has made several modifications in the old apprenticeship system in an effort to meet the present labor conditions. To give an idea of what is being done to assist young men in learning a trade, an outline of the plan is given below:

The teaching force consists of an apprentice supervisor and his corps of instructors. The functions of the apprentice supervisor is to acquaint beginners with shop conditions, direct the work of apprentices, and see that the efforts of instructors, leading-men, and foremen are applied to the best advantage, to the end that skilled workmen of good character are produced.

The instructors are chosen from men who possess marked teaching ability and who have had practical experience in the trades in which they give instruction.

Provisions are made so that apprentices have the best possible opportunity to learn the trade. The supervisor frequently appoints a leading-man to see that the apprentices have the privilege of working with first-class workmen rather than stay at one operation continuously.

After a period of probation, generally six months, an apprentice contract which sets forth the terms of apprenticeship is signed by the apprentice and the concern. In order to encourage the apprentice to complete his term, a bonus and a diploma are generally offered for satisfactory service. Evening classes are conducted from October to April inclusive for the special benefit of apprentices, and time credit is given for attendance in these classes.

Systems of pay vary, but it is a common practice to make a slight increase of a few cents in the hourly rate at the beginning of the second and third years, and thereafter semi-annually.

Training Disabled Men. What has been said above concerning training applies especially to the normal worker. The training of disabled men presents certain additional problems. Three preliminary considerations must be met before the actual work of training can be effectively done. First, the injured man must be encouraged to believe that he can be fitted to perform useful wage-earning service. Second, the public must be brought to consider the soldier, not as an object of charity, but as one who deserves to be educated and trained to enter a productive occupation. And third, the employer must be led to see the importance of providing simple special machine appliances which will assist the injured man in doing effective work and to be patient with him until he becomes adjusted to the new conditions.

While the government has assumed the responsibility for re-educating and fitting disabled soldiers and sailors to enter remunerative occupations, the work of training men injured in industry must be provided for in other ways. Judging from the trend of the practice among employers at the present time, it will not be long before the training of these men will be considered as great an obligation upon the management as the repair of machinery. As suggestive of practical working methods for training handicapped men, a brief statement of what is being done in Canada is given here.

Provisions for Training Disabled Men in Canada. In order to obtain the information necessary in determining the kind of training courses to be offered for returned men, surveys were made of nearly two hundred occupations. Upon the basis of these studies courses were outlined and vocational counselors were instructed in the work of placement. "There came a time," writes the Minister for the Department of Soldiers' Civil Re-establishment, "when it was realized that steps must be taken to prevent the disabled men from competing against each other in a certain narrow group of occupations. Consequently the department decided to train as many as possible of the men in industries and shops where they would subsequently be employed."

Men are placed with employers for all or for part of the period of training. Where only a few ask for courses in any locality men are brought to special centers for instruction and part-time work as in occupations for the blind, wireless telegraphy, dental mechanics, massage, commercial design, assaying, and other similar occupations.

The method in part-time courses varies considerably. In some localities all of the instruction and training is provided by the firm. In others, short preparatory

courses are given in day or evening schools under the Vocational Branch or Technical Branch of the Provincial Department of Education, and then the men are placed with firms for the remainder of the work.

Frequently special correspondence courses are provided for in connection with Institutes of Technology. Miners especially desire these courses. Local school boards may also offer instruction in night classes for returned men. When this is done the Invalided Soldiers' Commission pays about fifty per cent. of the cost.

Many of the returned men are given training in provincial institutions such as normal schools, colleges, and agricultural schools. These institutions furnish the instructors and equipment, and the Invalided Soldiers' Commission pays the cost of the books or other supplies and the maintenance of the men.

The Canadian system for the re-education and training of returned men is meeting with splendid success, as the following statistics will show:

On June 1, 1918, 4,876 men had been granted courses while the figure for May 1 was 3,861, that is, 1,015 cases were approved during the month of May alone. The number of courses in progress on June 1 was 2,077, of which 2,038 were being taken by discharged men. The number of men who had completed their courses and gone out into employment was increased from 351 to 481, making a total of 130 for the month.

CONCLUSIONS

A careful study of the present situation in the copper-smithing trade has disclosed the following important facts:

First, coppersmithing offers desirable opportunities to those who wish to learn a trade. The demand for workers is so great that helpers receive thirty-five to forty cents per hour while they are learning the trade. Skilled workers receive as high as seventy-two and a half cents per hour, with a bonus for faithful and efficient service.

Second, the outlook for the future promises continued development for the trade. New fields are opening up. Greatly increased numbers of workers, even after the war closes, will be needed. Probably no other trade presents better prospects from the point of view both of compensation and permanent employment.

Third, while the working conditions are not easy, men who, through the misfortunes of war or of industry, have lost a leg, a hand, or even an arm, or whose hearing has been impaired, or hands partly mutilated, can find employment suited to their disabilities and sufficiently remunerative to make them independent, self-respecting economic units.

Some Economic Aspects of the Coppersmithing Industry

NUMBER AND NATIVITY OF COPPERSMITHS

The United States census for 1910 gives the total number of coppersmiths employed in the various lines of industry in the United States as 3,185. Of this number 2,260, or over 70 per cent., were foreign born or of foreign parentage, while only 925, or less than 30 per cent., were Americans. Several reasons have been advanced as to why American youth do not take up coppersmithing. One reason is that they do not care to take the time necessary to learn the trade. As a rule it requires four years for a beginner to become a first-class coppersmith, and the pay while learning is much less than one can receive in other lines of work. The present high wages in other occupations are more attractive to American youth than the better wages they would receive in a few years after having mastered the copper trade. It is further suggested that the unattractive working conditions are repulsive to them.

Present conditions indicate that the proportion of foreign born coppersmiths has decidedly increased in the last few years. Three of the leading coppersmith shops of New England say that more than 90 per cent. of their men are foreign born or of foreign parentage. The employment manager of one of the largest shipbuilding plants in the country says that at least 98 per cent. of his large force of coppersmiths is foreign born or of foreign parentage. He holds that the chief reason why American youth do not take up the work is that foreign born coppersmiths are reluctant to teach the trade to them.

According to the thirteenth census the copper-smiths of the United States were employed in the following lines of industry:

<i>Automobile factories</i>	117
<i>Blast foundries</i>	36
<i>Brass mills</i>	43
<i>Copper factories</i>	1,749
<i>Electric factories</i>	31
<i>Iron foundries</i>	56
<i>Railroad shops</i>	867
<i>Shipbuilding</i>	251

More recent data indicate that the number of copper-smiths employed in automobile factories, shipbuilding plants, and railway shops is increasing. These lines of industry are more attractive to American youth, a fact which will, no doubt, draw more of them into the trade.

THE WORLD'S PRODUCTION AND CONSUMPTION OF COPPER

Copper is at the present time found extensively in various parts of the world. As early as 1250 A. D. copper was mined in Cumberland, England, a place which was famous for copper as late as 1470. During the fifteenth and sixteenth centuries England imported most of her copper from the continent, chiefly from Hungary. Early in the eighteenth century rich copper mines were found in Devonshire and Ireland, and from that time England produced the largest part of the world's supply of copper until the rich mines of North and South America were opened. As late as 1850 Great Britain was producing over 26 per cent. of the world's copper, while the United States was producing only 1.2 per cent.

In 1909 Great Britain's production dropped to only 0.06 per cent., while that of the United States rose to 58.2 per cent. of the world's supply. In 1850 the leading copper producing countries of the world in order of pro-

duction were Great Britain, Chili, Russia, the Austrian Empire, Australasia, Asia, Scandinavia, Germany, Turkey, South America except Chili, Africa, Japan, Mexico, Newfoundland, Canada, and the United States. In 1909 the countries ranked as follows: The United States, Mexico, Japan, Australasia, Chili, Canada, South America except Chili, Russia, Germany, Scandinavia, the Austrian Empire, Africa, Newfoundland, Turkey, and Great Britain.

Copper has for years been an important factor in our export trade. In 1913 just before the war broke out, more than one-third of the entire amount of nearly a billion pounds avoirdupois was sent to Germany and about one-fifth to Holland. In 1915 no copper was sent to Germany and only a small amount to Holland, while the amount exported to England, France, and Italy was 200 per cent. more than in 1913. The value of the copper exports (including spelter and brass) for the first eleven months of the fiscal year 1915-1916 was over three hundred millions of dollars, while for the corresponding eleven months of the year 1913-1914 it was less than one hundred and fifty millions of dollars. These facts show the importance of copper as a war commodity.

Alaska, 1915	35,348
Alaska, 1917	43,800
Other states, 1915	119
Other states, 1917	10,700
Total, 1915	694,005
Total, 1917	945,000

Map showing in short tons the production of copper in the United States for 1915 and 1917. The upper figures in each district are for 1915 and the lower for 1917. The total for the latter is over one-third more than for the former. In 1917 the United States produced more than 67.9 per cent. of the world's copper.

LOCATION OF COPPERSMITH SHOPS

While coppersmith shops are located for the most part in large industrial centers, usually near some important shipping port, they are fairly well distributed over the states east of the Mississippi river, and along the Pacific coast. This is a matter of considerable importance from the point of view of the desirability of advising returned soldiers and sailors to enter this trade. The experience of the Allies is to the effect that when returned men have been fitted for an occupation they desire, as a rule, to locate in or near their former place of residence. As coppersmith shops are widely distributed, a large number of men could find employment in them and still return to their home communities. Further, there would be this advantage; should a considerable number of returned men desire to enter this trade, they would be widely distributed, and the placement of a number of handicapped men in any one community would thereby be avoided.

While the following list of firms is necessarily incomplete, it will serve to show the wide distribution of copper shops throughout the United States.

CALIFORNIA: San Francisco

Oscar Krenz. Copper & Brass Works, 431 Folsome Street

C. W. Smith. Copper Works, 16 Washington Street

DELAWARE: Wilmington

Benj. F. Shaw Company

GEORGIA: Savannah

McMillan Brothers. Southern Copper Works

ILLINOIS: Chicago

Atlas Copper & Brass Manufacturing Company, 2738 High Street

F. Trenkhorst Manufacturing Company, 902 Larabee Street

INDIANA: Indianapolis

F. H. Lansenkamp, 130 East Georgia Street

KENTUCKY: Louisville

Ahler & Gregoire, 621 East Main Street

Corcoran, Matt & Company, 118 North Fifth Street

Vendome Copper Company

LOUISIANA: Donaldsonville

Wm. Dill

MASSACHUSETTS: Boston

E. B. Badger & Sons, 75 Pitts Street

S. D. Hicks & Son, 9-17 Bowker Street

National Copper Works, 140 Washington Avenue, North

MASSACHUSETTS: East Boston

Bertelson & Petersen Engineering Company, 256-264 Border Street

Boston Copper Works Company, 84 Marginal Street

MASSACHUSETTS: South Boston

Dahlquist Manufacturing Company, 36 West Third Street

Gerstein, Brass & Copper, 1-3 West Third Street

MARYLAND: Baltimore

Lawrence Ellerbrock, 29 South Frederick Street

John Hubert, 1714 Thames Street

Jos. Kavanaugh Company, Pratt corner Central Avenue

MICHIGAN: Bay City

Schepper & Covert

MISSOURI: St. Louis

Aufrichtig Copper & Iron Works, 900 South Third Street

Meaker Brothers Iron Company, 421 South Sixth Street

Seibel-Suessdorf Copper & Iron Manufacturing Company, Second Street, corner Lombard Street

NEW JERSEY: Hoboken

Flynn Brothers

NEW JERSEY: Jersey City

L. O. Koven & Brother, 200 Ogden Avenue

Smith & Daubt

NEW JERSEY: Newark

L. Lawrence & Company, 292 Halsey Street

Theo Walter, Jr., 13 Essex Street

NEW JERSEY: Paterson

Charles Brabender, Sr. Paterson Copper Works

NEW YORK: Brooklyn

Atlantic Basin Iron Works

NEW YORK: Buffalo

J. P. Devine Company, 1380 Clinton Street

NEW YORK CITY

Gerdes & Company, Incorporated, 40 Church Street

Griscom-Russell Company, 90 West Street

P. H. Kearney & Sons, 504 West Twenty-seventh Street

A. Louy & Company, 511 West Twenty-first Street

OHIO: Cincinnati

American Copper & Brass Works, 612 South Front Street
Geo. F. Klotter Company, 1722 Central Avenue
Vulkan Copper Works Company, 122 Sycamore Street

OHIO: Hamilton

Hamilton Copper & Brass Works
Ohio Copper & Brass Works

PENNSYLVANIA: Johnstown

Geo. Muehlhauser & Son

PENNSYLVANIA: North Philadelphia

F. J. Stokes Machine Company

PENNSYLVANIA: Philadelphia

Ford Brothers & Company, 1610 Front Street
Jos. Kopperman & Sons, 307 Florist Street
Geo. F. Ott Company, 213 Buttonwood Street
Philadelphia Coppersmithing Company, 226 North Front Street
Emil Shaefer, 1320 North Fifth Street

PENNSYLVANIA: Pittsburgh

Stender Coppersmith Company, 2932 Smallman Street

VIRGINIA: Norfolk

R. A. Burroughs & Company, 1006 East Water Street

WASHINGTON: Seattle

Seattle Copper Works

WISCONSIN: Milwaukee

Herman Weissleder Company, 816 Winnebago Street

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Sample

**Publications of the Red Cross Institute for
Crippled and Disabled Men**

Edited by Douglas C. McMurtrie

II

February 25, 1919

Number 5

**Bedside and Wheel-Chair
Occupations**

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Marblehead, Massachusetts

the Red Cross Institute for Crippled and Disabled Men
311 Fourth Avenue New York City

Bedside and Wheel-Chair Occupations

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*Four-harness loom on which very elaborate
and beautiful patterns may be woven*

Preface

THE following chapters contain the substance of some lectures which were given to the classes at the Boston School of Occupational Therapy. I have tried to make clear some of the limitations and the possibilities of bedside occupations. What is the use of teaching handicapped soldiers or civilian convalescents a lot of trivial crafts such as basket-making and block printing when they need so much to be on their way toward self-support. Is it not a waste of time? The answer is 'yes, most assuredly', unless the bedside occupations are used largely as a means to an end; unless they are abandoned as soon as the patient is able to do something more valuable and purposeful.

Used for a short time in early convalescence, the small crafts are of the utmost importance—they are first of all diversional, then constructive. Many a convalescent fails to make any progress at all without some easy occupation which does not tax his newly-found strength; some occupation which interests him, which builds up his resistance and his ability to sustain effort.

It is becoming more and more evident that bedside occupations, coming with their stimulus and encouragement at the turning point between helplessness and convalescence, represent a very important element of treatment—a small but indispensable factor in the program of rehabilitation.

CHAPTER I

Bedside Occupations for Convalescent Soldiers

IN the medical history of the war there is nothing more striking or significant than the increasing use of manual work as a means of restoring lost efficiency and morale. Always it has been known that work, rightly used, is an efficient remedy; that it is needed, sooner or later, to complete the cure of any disabled man or woman. The remarkable thing is that the principle has all at once come into such wide recognition and acceptance and that some sort of occupation is now looked upon by so many medical men as essential as soon as the patient can possibly use his hands. Work as a remedy is coming into its own. It is already prescribed like medicine and usually is taken by the patient with the same confidence that he has in the pill or the draught.

Major John L. Todd, who has studied the French system of 'Return to Civil Life of Crippled and Discharged Soldiers', writes in his report: "There is a strong opinion that *work* properly selected and graduated has a high psychic value and constitutes the best possible means of reaccustoming muscles to action." In plain language he means that the best way to bring back courage to a wounded soldier and the best way to restore the use of a stiff elbow is to employ the man and his elbow in useful work, naturally taking care not to overdo the process. This seems like nothing more than common sense, and yet it has taken the great war to give point and emphasis and general acceptance to such a simple truth. Before the

war we were commonly using all sorts of artificial methods in our treatment of injured joints and muscles and nerves—elaborate exercising machines, massage and electricity. We are using these measures still, but we know now that little purposeful and well-directed work will often do well or better. Later in his report Major Todd says: "Not the least of the advantages of work done in hospital workshops under the direction of medical men is that it furnishes an early opportunity of observing patient's aptitudes, and consequently, facilitates making of a sound and early choice of occupation for him."

If we wish to know how important our military authorities consider the general field of physical rehabilitation means of prescribed work, we have only to note that France alone there are sixty-nine centers of industrial re-education.

Our own government has taken the matter in hand and has given serious thought to a system which shall afford the crippled soldier an opportunity to win his way back to self-support and self-respect. In a war of great magnitude the old policy of pensions and soldiers' homes is not of at all. In sheer self-defense the governments of the world must undertake to reinstate the crippled man in industrial life. The burden of public support cannot otherwise be borne. But, fortunately, this is not the only consideration. Surely, every one is waking to the knowledge that the idle man is a serious menace to himself and to the whole social fabric. To himself, most of all, idleness means degeneration of body and spirit. Any one who will read Bulletins 5 and 6 of the Bureau of Vocational Education, will be sufficiently impressed with the comprehensive plans which have been made, and he will thoroughly this principle is appreciated.

There is in almost every convalescence a time of discouragement and depression—a time when the patient

begins to realize what his handicap means. He looks ruefully at the stump of an arm and the future seems dark enough. A few rise above depression and need no encouragement; but the majority require at least diversion, lest depression settle into despair and despair into chronic failure. What if the diversion can take the form of some simple work which will demonstrate that with care and patience almost any handicap may be overcome? That is, the function of the so-called bedside occupations which have been used very extensively abroad and which will receive full attention here in our own military hospitals. There are other and, perhaps, more important stages of the plan—the curative workshop where heavier and more purposeful work is done, and the vocational schools which will undertake to prepare their pupils for the trades so that they may overcome the handicap of the cripple through the advantage of advanced knowledge. But in this chapter I wish to discuss only the smallest phase of the great problem—the bedside or diversional occupations. They are important out of all proportion to their apparent use, simply because they come at the critical time when a man turns for better or worse—when he begins to face life, or when he turns his back upon life's possibilities and begins the career of the dependent. The problem is, to a considerable extent, mechanical. Hand work will gradually unlock stiffened joints and bring to life again nerves and muscles which have been badly injured. But all the time lost confidence will be coming back and subtle improvements in morale. The man who has lost his right hand and who learns to write with his left, accomplishes more than he realizes, for he discovers that he is still a man.

For the necessarily simple bedside occupations we naturally turn to the so-called handicrafts. They may be made to exercise most of the faculties of mind and body.

They are capable of wide development and may be carried to any degree of perfection consistent with the limitations of the worker. Fortunately, they combine the elements of work and play.

In the more strenuous occupations of the curative workshop and the vocational schools, most of the teachers and assistants will, of course, be men, many of them recruited from among the patients who recover from wounds and who, from previous occupations, have already the expert knowledge necessary for teaching. The development of the bedside occupations will, for the most part, fall into the hands of women.

Realizing that there are not enough women who know the handicrafts and who also know how to teach, the Surgeon General's office sometime ago sanctioned the establishment of schools for the training of Reconstruction Aides.¹ I quote from the prospectus of the Boston School which has been conducted at the Franklin Union:

There is an immediate need in our military hospitals for trained women to furnish forms of bedside occupation and to direct the hand-work of disabled soldiers.

The purpose of the school is to furnish in the shortest possible time, the necessary training to young women who wish to become qualified for such work and to receive appointments as Reconstruction Aides in Military Hospitals.

The training is designed to develop not only artistic and mechanical skill and dexterity, but also ability to cooperate with every branch of a hospital in order that there may result the highest standard of efficiency in the rehabilitation to civil life of the returning soldiers.

Applicants must be at least twenty-five years of age; must be citizens of the United States or of Allied Countries; must possess suitable personality—this requirement is regarded as one of great importance; must demonstrate some artistic or mechanical skill or training that will especially prepare them to excel in one or more of the major sub-

¹ The policy of the Surgeon General's office has changed from time to time. At present no school or course of study is officially sanctioned, but any woman who can qualify in one or more crafts and who has evident tact and adaptability may be accepted for military hospital work.

jects of the course; must be prepared to accept assignments—if appointed—for full-time service during the present war emergency, either at home or abroad.

The directors of the School reserve the right to refuse admission to any applicant, or to grant admission only upon probation.

A tuition fee to cover a portion of the expenses of the course will be charged all applicants. The fee will be \$60 for the complete course.

While no definite statement can be made regarding scholarships, it is hoped that any applicant who is thoroughly qualified will not be denied admission because of embarrassment concerning payment of tuition fees. Any applicant, therefore, who finds the tuition a decided hardship is urged to write at once to the Directors.

The teachers in charge of the various courses will be experts in their respective subjects and there will be expected of all pupils a high degree of excellence in all the work.

OUTLINE OF COURSES

Weaving. To include hand-loom, bead-loom, and simple rug and mat-making.

Simple Wood Work, Whittling and Carving. Confined to the use of a few instruments, such as the knife, chisel, and gouge.

Basketry. To include reed work and, possibly, pine needle work.

Block Printing. Applied to paper and textiles.

Knitting. Crocheting, needle work, and bead work.

Applied Design. Including the elementary principles of design bearing on the subjects taught in the course.

Practice Teaching. Actual practice in teaching the required subjects in hospitals under conditions like or similar to those which will be met in military hospitals, will give the self-confidence and experience necessary for military hospital work.

Hospital Routine and Methods of Invalid Teaching. By lectures, conferences and visits to institutions, training is given in the conduct of hospitals and the methods of teaching the convalescent.

Certificates. Certificates of graduation will be granted to all students successfully completing the course. Graduates will also receive confidential letters of recommendation concerning their ability and personality. Both certificates and letters of recommendation will unquestionably be of great service in securing appointments.

Appointment. The school, of course, even though authorized by the War Department cannot guarantee appointments as Reconstruction Aides in the Military Hospitals upon graduation. It can merely

state that there appears to be an urgent need for every one who can make herself competent.

Compensation. The Reconstruction Aides if appointed for service within the United States will be paid fifty dollars per month, and sixty dollars per month for service without the limits of the United States; and if not living at a hospital, they will draw twelve dollars per month for quarters and at least one dollar per day for subsistence. They will be uniformed in the hospitals and on the street; the expenses of these uniforms will have to be borne by the Aides.

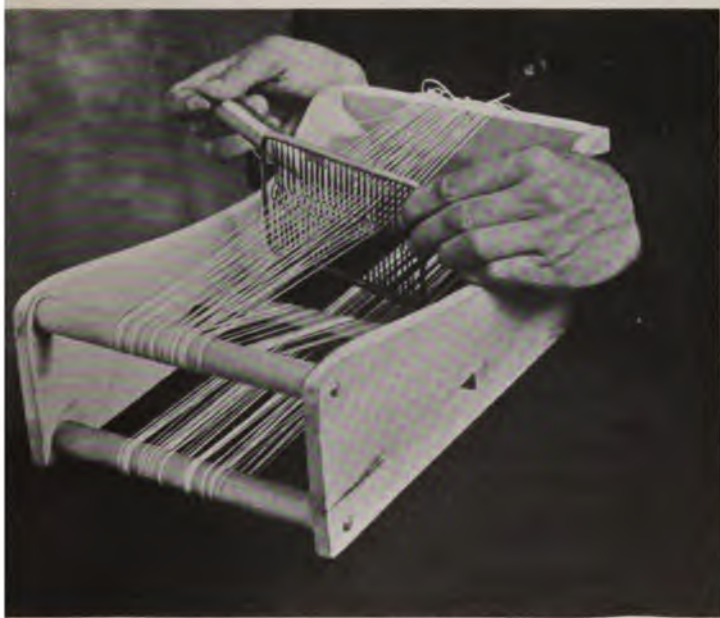
Here is an opportunity for women of the right qualifications to aid materially in a very important war work. What are the right qualifications? The prospectus says there must be suitable personality. This is undoubtedly the most important consideration. In three months of preparation it is not expected to produce a large number of expert crafts-women. A reasonable cleverness in acquiring the technique of simple hand work—very few will fail at that; but suitable personality is another matter—it cannot be acquired. It is a serious business, this good start on the right road for the crippled soldier. If the work is made a joke or a kindergarten exercise, then bedside occupations will do more harm than good. Equally fated will be a too-technical or matter-of-fact approach. My feeling is that the young woman who is to succeed in this work must have that subtle possession we call tact; also she must have charm and appeal; in short, an attractive personality.

The age of twenty-five is certainly an arbitrary limit of youth. There are many younger women who could serve successfully. But on the whole, maturity is desirable in such a work, and I know women of fifty who would undoubtedly succeed. Men are pretty much alike the world over; they will be lead if they are attracted, they will do nothing if they are not interested.

A very important part of the training of medical crafts-teachers will have to be given by medical men who are



"Wunder Weaver" school loom



Small hand loom which can be used in bed

able to make the pupils understand not only the special kinds of work which will be most useful in given cases, but who will teach the vagaries of fatigue and its manifestations. Nothing could be more unfortunate than a tendency to push the men too fast, or to dally when progress might be made. Before graduation from these schools the pupils should have clearly in mind the importance and dignity of their work. They should be able to approach their patients in a way at the same time intelligent and interesting. What a chance is here for the sympathy and understanding which no school can teach, but which is in the heart of every true woman.

Medicine and surgery must play their greater part; but doctors will learn to rely more and more upon therapeutic work for the physical, nervous, and moral reconstruction, which must follow medical treatment and without which much of the brilliant work of the operating room and the laboratory will be lost. They will understand finally that though the medical handicrafts seem, at first thought, quite foreign to the hospital function and tradition, they are really a logical part and not a small part of the rehabilitation plan. If the work itself seems trivial it is only necessary to remember that a child must walk before he can run, and that the convalescent must perform the simple tasks before he may wisely undertake greater.

CHAPTER II

Medical Handicrafts

QUITE suddenly, it seems almost overnight, the bedside and wheel-chair occupations have come into prominence as military hospital requirements. Classes of young women are trained in three months or less to teach arts and crafts. What would John Ruskin or William Morris have said to this blossoming out of crafts-teachers—and what quality of products can be expected from such meager preparations? The Surgeon General's office states that the bedside occupations are 100 per cent. medical in their object, that there is no intention of developing real craftsmen. Perhaps it is well that Washington takes this stand, for a high expectation of craftsmanship is likely to be disappointed. And yet the fact remains that poor work of any sort, badly designed and badly executed, must react unfavorably upon the patient.

The reasonable conclusion is that we must not neglect the quality of the products if the bedside occupations are to have their full value. We shall not fail in this respect, because, first of all, a very large proportion of the young women who are asked to teach will have had satisfactory craft training or experience in teaching before entering upon the government-advised course, and because such a course as that outlined in the previous chapter is really good and sensible. It is not too ambitious, it does not attempt the impossible. We are not trying to produce craftsmen, in the old, original sense, the kind of workmen who wove great tapestries and carved cathedral choir screens. Our teachers and their pupils are to work on a

much lower level, yet there is no reason why their products should be poorly designed and executed.

What are we planning to make in the wards of the hospitals? According to orders or suggestions from Washington, the list of occupations is as follows: hand weaving, bead work, basketry, wood carving, block printing, knitting and crocheting; to these may be added a considerable variety of small handicrafts at the discretion of the various committees. As a matter of fact, a very fair teaching knowledge of any or all of these occupations may be acquired in a few months' work by the so-called Occupational Aides. Design, in my opinion, is a thing apart. Here and there a teacher may have had the necessary training before coming to the classes, but usually design and color schemes must come from expert sources if the work of the teachers or their pupils is to be satisfactory. If this one point is made and followed, the products of the bedside and wheel-chair occupations are likely to be worth while in every sense. There is, in point of fact, no reason why we should not have the ideas and suggestions of the best designers in the world for use in this good cause. The Government can afford to pay for the best in design if by so doing the medical handicrafts are saved from failure and are made to fulfill their complete purpose.

The men who are to pursue medical handicrafts as a part of their convalescent treatment will, of course, be handicapped in many ways. There will be actual physical crippling, to say nothing of the natural discouragement and depression and the easy fatigue of the convalescent. Still, judging from the results of such work in Canada and abroad, we may expect an interesting and valuable product from our handicapped industries. The men will come from all walks in life, some will inevitably do poor work, many will be clever enough for anything, the average is likely to be good.



Interesting fabrics woven on hand looms by convalescent workers



Soft woolen blankets for babies' cribs. These blankets done in colors are very attractive and can be made at a good profit by skilled hand weavers

But why lay quite so much stress upon the quality of the products? If they are passably good they will not react badly upon the workers. Why take the bedside occupations so seriously? My own experience, before the war, makes me believe that men, who, because of some very great handicap may never succeed in doing much else, can be trained and directed so that the work of their hands will be commercially and artistically justified. There is not a single argument in favor of making hand-weavers or silversmiths out of crippled men who have no natural aptitude for such work and who might with re-education become fairly competent factory or shop hands. But there are many small occupations, small crafts, such as those which have been mentioned, which might be developed under government patronage for the benefit of the handicapped and with good commercial as well as medical results.

Let us suppose that out of a hundred men who are put through a course of bedside occupation after crippling injury there is one who can never earn his living at his old trade or any new trade of the ordinary sort. Suppose this man shows also a special understanding of form and color, a special liking for one of the so-called handicrafts, such as weaving or block printing—may he not be made the nucleus of a craft system which will later justify itself in every way?

I hope and believe that some of the young women who are to be Occupational Aides in the military hospitals will some day be able to carry out the complete idea of worthwhile occupations for the handicapped. In this way, it would be possible not only to raise the standard of the crafts, but such enterprise might be the nucleus of a school which could supply training for able-bodied craftsman teachers and at the same time create a tradition of permanent use to hundreds of handicapped men and women.

Those who have watched the somewhat dubious progress of the so-called crafts in certain state institutions, in sanatoriums, and in the crippled schools, may well question the advisability of any attempt to put craftwork on a commercial basis. A large part of the good material used is wasted and the world is no richer for the lopsided baskets, the hammered brass and the tooled leather that has been produced. But there is a middle course, somewhere between a factory system and the work of individual craftsman, a middle course wherein the carefully directed industry of crippled workers may be pursued with legitimate results. Take, for example, the making of willow furniture. Here is a field which was once at least tried out by cripples. They succeeded in making the furniture—it was well and substantially made, but it had no originality. It was no better than the same sort of thing made by machinery or, at any rate, turned out by the thousand pieces in factories. Therefore the enterprise failed as it deserved. It would have been perfectly possible with the same amount of labor to have made a really beautiful and distinctive furniture which would have had immediate and profitable sale. This little incident, which actually occurred, is very significant—we must not lose the lesson.

Some fourteen years ago, while still a general practitioner, I established a pottery-making plant for the benefit of my patients. I had to make it pay, for I had little capital. By employing a really expert designer and chemist, this work was put at once upon a high technical and artistic basis. The business did not fail, but progressed until it is now and has been for years on a paying basis. This work did fail of perfect medical usefulness because it became so technical and professional that comparatively few invalid workers could be employed. But it showed the possibility of maintaining a practical and self-support-

ing craft undertaken as a medical experiment. A like good fortune has followed a hand-weaving industry which was established at the same time and for the same purpose.

Of course, self-support is not always necessary so long as the medical ends are gained and the invalid occupations do not become too expensive. But I have believed from the first that the better the craft the greater the medical value, whether we use the industry as diversional and re-educational only or as a means of partial livelihood.

The bedside occupations of the military hospitals will prove of great indirect value if they popularize the idea of work as a cure, and if they show that properly conducted handicrafts may be justified in every sense of the word. After the war emergency is over, it will be increasingly evident that we cannot afford to neglect the potentialities of crippled industrial workers anywhere. The bedside occupations will then come to their long needed and permanent application. They will start on the way to recovery many a crippled worker who would, without them, fail of any progress. If such work is organized, protected and developed with care, there is no end to the possibilities.

I do not pretend to know the best way to bring about the humane and economic plan of special industries for the handicapped, but I am inclined to believe that it can be carried out in connection with general or special hospitals, or as an adjunct to existing factory systems. I do not believe it is necessary to create an entirely new organization. Is it not logical to consider the moral and economic rehabilitation of an injured man or woman a definite part or extension of the hospital treatment? As a matter of fact, the whole social service system now so firmly established in most progressive hospitals, is of a piece with industrial rehabilitation.

I must not wander too far from my subject which is bedside and wheel-chair work. The very definition implies the hospital, but the hospital is a place for medical and surgical treatment—naturally these come first. We cannot turn the wards into workrooms. But the idea that the hospitals' responsibility ceases when the wound is healed is fast disappearing, and I prophesy that before long occupational aides will become an indispensable part of every well-equipped hospital in the world.



*Whittled out of a solid block of wood by one of the
Occupational Aides at the Boston school*



*This wooden chain, done with a jack-knife by a young
woman, proves that clever whittling is not an
exclusively masculine accomplishment*

CHAPTER III

Fatigue and the Bedside Occupations

IF you attach the leg muscle of a frog to a proper recording apparatus and give the muscle repeated electrical stimuli, you may produce a typical fatigue chart, showing the onset of fatigue and its termination in complete exhaustion; but you will learn very little about the complex phenomena of fatigue as they occur in human experience.

Human fatigue may be theoretically as simple as the frog's leg. If there were absolutely no mental or emotional elements involved we should have just plain tire as when a man walks until he can walk no longer. But almost inevitably the emotions play their part. The hunter sees the camp smoke rising above the trees, his tired muscles revive and the rest of the journey is easy. On the other hand, we all know how unreasonably tired we grow when there seems to be no end to the road and no hope of rest and refreshment.

I shall not attempt a definition of human fatigue, nor shall I try in any serious way to analyze it. We know fatigue, in its various forms—we have it ourselves or see it in others. Only when it interferes with progress, with our aims and ambitions, do we think of it as a menace. Ordinary tired out feelings we may look upon as normal, inevitable, perhaps wholesome when they bring deep sleep and refreshment. But plain tired-out too often repeated does harm which may only with difficulty be repaired. We have, for example, the athletes who overtrain—such men are really weaklings, they often die young, they succumb easily to disease. Mental fatigue in

its milder forms apparently does no harm. The school boy or girl feels it almost surely in our modern system of cramming. Mix worry, discouragement and fear—together with some unknown factors of poor resistance—and you have the ingredients of serious nervous breakdown in which fatigue and the sense of fatigue may figure largely.

We soon discover as we deal with our so-called nervous patients, as well as with those who are physically unsound, that physical fatigue and what, for want of better terms, we may call mental or psychic fatigue, are often apparently alike in their manifestations, that they often occur simultaneously, and that they seem to bear little or no relationship to physical exertion or even mental exertion. Perhaps some day we shall discover that there is always some physical disease or unbalance to account for the strangely severe disabilities which we are apt to call nervous prostration or nervous exhaustion and which are so often associated with fears, obsessions and hypochondriacal worries. We know little enough about the functioning of the human system. Only very recently has it been realized that the ductless glands, the thyroid, the supra renals and the pituitary body, may in their over or under secretions produce the most profound disturbances of mind and body.

I think we may be reasonably certain, however, that mental attitudes do react upon all the functions and produce, or at least intensify, the suffering and disability which we call fatigue. We know well enough how promptly loss and sorrow will rob us of appetite and put out of order all the well-ordered mechanisms of the body, and we know how good news brings renewed vigor.

Whether it seems justified by the facts or not, the feeling of fatigue is a thing to be reckoned with—we cannot ignore it; it modifies our lives whether we will or

no. It may be simply a warning that we have gone far enough. But it may be much more, and in settled forms may constitute real illness. This is not a medical treatise, you are not required to know all the conditions which may produce fatigue, but you are to have your small part in the reconstruction of crippled soldiers, and you will have to deal with the problem of fatigue. You will have an exceptionally good opportunity to help in the relief or cure of this disabling symptom if you approach the situation intelligently, if you recognize fatigue when you see it, if you give it due weight but not too much importance.

Fatigue, then, is a symptom occurring in many and diverse conditions of body and mind. It may range all the way from a healthy tire to a deadly exhaustion. The medical treatment of fatigue is usually and logically the treatment of the underlying conditions. You have nothing to do with that—it is the field of medicine and surgery. But you may be of great service to your patients and to the medical staffs of the military hospitals if you understand in a general way how to deal with fatigue as a symptom. Sometimes, indeed, you may dispose of this troublesome handicap altogether if it is due to one or another of the simpler causes.

I wish there were some reliable measure of fatigue—something like a blood pressure indicator which would tell at a glance the degree of involvement. But fatigue is far too subtle for any indicator save that of intuition and experience. People generally know when they are tired and say so in no uncertain terms, but we cannot always accept such statements at their face value. The fact is that the sense of fatigue often outlasts the justification and becomes a sort of protective habit which must gradually be broken down. But often, on the other hand, the reverse is true, and we find an ambitious patient re-

personally exhausting himself in well-meant, but foolish attempts to overcome his handicap.

My experience has made me sure that fatigue, even that which is due to serious organic disease as well as to long-continued pain or to protective habit, may often be relieved with untold benefit to the patient by a simple process of graded effort, of carefully regulated activity.

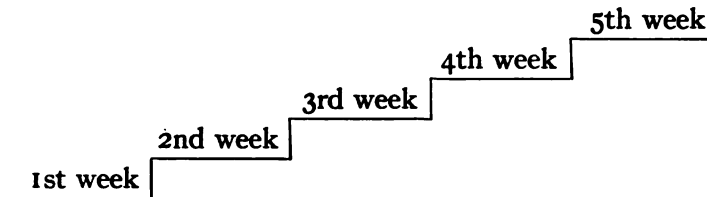
It is necessary to begin with very slight effort. Anyone who understands physical or nervous exhaustion knows that sudden demands may be answered for a while, but that fatigue is sure to follow unless the resistance is built up slowly and consistently.

You will see at once the possibilities of the small movements. They may be made to serve as a ladder upon which the weakened and fatigued patient may climb back slowly to efficiency, disposing of fatigue as he goes. With your work as a guide, you will learn to recognize fatigue when the patient denies it—you will see the fluttering pulse, the rapid pulse, the weary expression, the heavy eyes which tell the story. If you are wise you will manage in such a way that real fatigue rarely occurs.

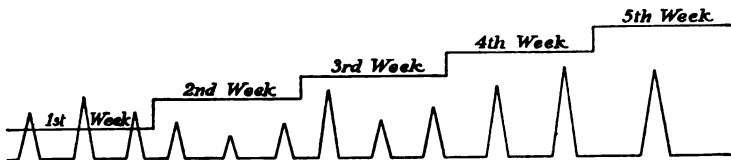
At each stage of reconstruction the patient will find that when he undertakes any work, no matter how slight, the fatigue and fatigue should rarely be more than a passing thing. It is a useful rule to observe as to the fatigue which disappears within a few hours after work and as fatigue or exhaustion a suffering which does not require a day of rest.

There is a danger that progress in these lines, to be maintained, must require a little more effort each day until the movement is mastered. Such a course will succeed immediately but when it ends in discouragement and defeat because the added weight each day becomes too soon a

conscious burden. A much safer progression is in a series of planes. By this plan we give the patient the same task and no more for a number of days, perhaps weeks, until the improvement and resistance up to this point is firmly established. Then we may safely move on to another plane. We must never forget the mental element in fatigue, and whatever may be said of the physical possibilities we cannot wisely confront the patient with too steep and discouraging a progression. The progression which I have advocated may be represented graphically by a chart.



Fatigue as it affects the patient and interferes with his progression may be represented by a series of sharp elevations which rise into the first week or two but which fail to reach the levels of subsequent weeks except perhaps occasionally because of some untoward circumstance.



SHARP POINTS REPRESENT DEGREES OF FATIGUE

On the other hand, a too-rapid attempt at purposeful effort, the sharply inclined plane, may be depicted by steep inclines with deep depressions at the end from which recovery will be slow and painful, only to be followed by subsequent falls and further serious depressions.



As you gain experience with fatigue of various origin you will discover that there is a daily wave of strength and resistance which is normal and which mounts rather quickly in the morning to a maximum, falling slowly through the day.



This daily chart is not by any means constant, but it is approximately true and the rule may not wisely be disregarded. I have known many patients to fail in their efforts at rehabilitation because they would begin their work too vigorously in the morning, thus failing to take advantage of the natural wave of energy. You will understand that your patients should commonly undertake their bedside occupations in the forenoon and not in the early morning or late afternoon. Fortunately this requirement will usually coincide with the hospital routine, for dressings and other treatments are usually carried out early in the day.

It is important for you to realize that long-sustained effort may be impossible at any time and will be followed with bad results when a series of small efforts with rest intervals may be successful and effective. Broken or fractional effort may be likened to the action of the familiar automobile jack which lifts easily by slow and short degrees a weight which the operator could never manage in one sustained effort.

In America we are too apt to rush things, we go through the day at top speed, hardly stopping for our meals. It is more than likely that nervous prostration, which has been called the American disease, is prevalent among us partly on that account. The English people divide their day better and more consistently with the laws of fatigue. They begin the day later, they always stop for tea in the mid-afternoon. Afternoon tea which we are apt to ridicule probably saves many a man and woman from fatigue and nervous collapse. It is a pause, an interval which allows the accumulation of energy.

The results of bedside occupations will vary greatly. Sometimes you will accomplish wonders and produce marked improvement in strength and resistance to fatigue. You must not be discouraged by poor results, or too much elated by apparent success. The elements involved are so subtle that you may never know what you have accomplished. Your apparent failure may be your greatest success. You must yourselves be careful to avoid fatigue for your work will be essentially tiring. There will be great drafts upon your sympathies and upon your patience. You will have to be in a sense impersonal, doing your work as the surgeon does his, steadily, calmly, not allowing yourselves too much personal feeling for the men, lest you lose your nerve and cease to be useful.



Lamp in concrete, designed and made by a convalescent



Cement bowls made by convalescent patients

CHAPTER IV

The Modern Treatment of Nervous Exhaustion

WHEN a man is ill, when he complains of painful and disabling symptoms, the modern doctor begins to search for the physical cause of the trouble. If he fails to find one of the recognized sources of pain and disability, eye strain, ulcer, malignant growth, disease of the blood, or something tangible, he puts it all down to 'nerves'.

Nervous exhaustion is still a difficult field, but we are beginning to regard it more rationally. No longer do we treat the symptoms as though they were the disease. They are too many and too varied, they do not lie at the root of nervous illness, they are only surface manifestations of trouble underneath. There was a time when doctors and laymen alike were inclined to scoff at the victim of nervous exhaustion with his pains and aches, his belchings of gas and his fatigue. It was thought that the symptoms might be cured by the exercise of the will. We now know that there are possible physical causes which were not understood before, and which may not be understood for a long time to come, but, more important still, we know that there are mental causes capable of upsetting the bodily functions of anyone who is not exceptionally endowed with resistance.

Probably the extraordinary manifestations of 'shell shock' coming daily from the battlefields of France will make clear as never before what profound physical disturbances can be caused by mental strain—long continued or sudden and overpowering experience of violence. I am

writing not as a military surgeon, for I have had very limited experience of that sort, but rather from a knowledge of nervous exhaustion as it occurs in civil life.

It is quite possible that experience in dealing with 'nerves' in our sanatoriums and in private practice needs only to be extended in kind to meet the greater and more pressing requirements of the service.

Nervous exhaustion in one form or another is the accompaniment of most long and painful illnesses. Just what happens, what change takes place in the mind and body to cause the varied symptoms of weakness and inefficiency, we do not know nor do we need to know, for the moment at least, if we can relieve the condition.

As people differ in their make-up and resisting powers, so the picture of nervous exhaustion will vary even though the cause be constant. One man will go through a terrible experience, shrug his shoulders and be ready for the next shock. Another, with a less stable mind and less physical stamina, will be thrown into convulsions or will temporarily lose his mind and remember nothing about the matter when he comes to himself. A third will develop some entirely different symptom like persistent headache, a rapid heart, or an all-pervading fear of impending disaster. The outstanding and almost constant elements are exhaustion and inefficiency, together with a curious inability to regain strength and confidence when the acute part of the illness has passed.

We are fortunately able to apply a broad and logical remedy which fails to help a few but serves a useful purpose with almost every patient who does not convalesce rapidly or who shows the familiar symptoms of exhaustion. This remedy is modified and prescribed work.

It may be profitable to study a little into the general principles which underlie this treatment and which have made it valuable. We must not suppose for a moment that

the work alone is responsible for the gains which are made. But work is much more than a background for other treatment. A man who has been incapacitated for a long time finds the greatest satisfaction and general encouragement in the successful accomplishment of some very simple task. Is it the bit of work which he has done or the partial return to life which has acted as a tonic? Successful, healthy life is made up of emotions and ideals as well as of facts. Work which earns the daily bread is useless in the moral sense unless it is backed up by ideals and high emotions. I believe that without inspiration, perhaps I had better say faith and hope, no amount of work would serve to cure or even to relieve the depressed and worn out patient. Under special and favoring conditions work and encouragement go together; they support and justify each other. There exists in nearly all of us a natural hopefulness and cheer which often needs only to be released to become effective. With hope and ambition, anything is possible, we accomplish miracles. Without them we are the prey of morbid thought and obsessions—our bodies cease to function properly, we become ill. If we happen to have delicate bodies or a fine nervous balance we become nervous invalids with all the varied symptoms and disabilities that are involved. I do not mean that discouragement always precedes or accompanies nervous breakdown—usually it does, but I am sure that courage and hope invariably improve the condition of the nervous invalid and give some chance of a cure.

This is the justification of work as a remedy—it brings a man back toward the normal by convincing him that his case is not hopeless, it releases a natural courage and enthusiasm.

Every exercise and treatment that stimulates circulation and nerves, every drug and medicine, will fail of the

best results unless something helps to restore enthusiasm, confidence and faith. Confidence we know can come with work accomplished, even though it is only the trivial work of the bedside occupations in a sanatorium or in a military hospital. Faith is a step in advance, at least the faith I mean. Without it or its equivalent any cure is incomplete and fragile. Faith goes far beyond work and its accomplishment. It comes when we see justification in life, when we believe that life means something more even than 'liberty and the pursuit of happiness'. When faith comes, it is like a breath of good clear air after one has been cooped up in a theater all the evening; when we come out under the stars and know that there is something greater than our own inventions, something better than the air of the playhouse. An experience such as this, the nervous patient must have if he is to be wholly freed from his terrors. Then he must back up his gain with the sobering, balancing influence of work.

Keen observers have been saying for some time that one reason for industrial unrest, for strikes and sabotage, for the poor and ineffective performance of the average workman, one reason for nervous breakdown, is to be found in the modern subdivisions of labor, in the fact that no effort is made to interest the workman in the larger aspects of his work. The old time craftsmen worked long hours for scant pay and found no fault. They saw the beginning and the end of their work, and found it good.

I remember sitting for hours beside a serene old man, one of the last of the shoemakers who made the whole shoe. I was fascinated with the slow, sure progress of the work. He worked until late twilight—until he could no longer see to thread his needles. He could talk as he worked. The little shop overlooked the sea and we talked



*One of the original toys made by
patients at Devereux Mansion*



*Wooden figure made by patients
at Devereux Mansion*



The Army Mule. Wooden toy made by patients at Devereux Mansion

of old-time ships. The shoes my friend made would not wear out in a few weeks, there was good leather in them and no pasteboard in the soles. Also there was no sign of nervous prostration in the worker.

Within a year I have seen the nervous life of a young girl well nigh wrecked by the rattle and clash of a modern shoe factory where the cry was always more speed and where the windows were of painted glass so that the workers would not be distracted by the passing of traffic on the street outside. The girl earned more in a week than the old shoemaker did in three or four, but she broke down under it, and so have many more.

No doubt machines and the so-called efficiency methods have come to stay, but perhaps these methods will be modified some day so that the worker will have more interest in his product, so that he will catch a glimpse of the significance, the human value of his labor. Whenever the laborer is given a wider vision he is a better man, he works longer and harder and is less likely to break down.

These great principles are important enough in industrial life. They are pertinent in our present discussion because they explain in a way why the small crafts of the bedside occupations have such an extraordinary effect upon the convalescent worker, starved as he very likely is for the primitive joy of creative work. The bedside crafts must be very simple, the results must come quickly and without much complication else fatigue spoils everything. But there is real curative value in the crafts. Even if the patient must go back to the machines and the painted windows, he will have been refreshed and encouraged by a brief experience of more wholesome conditions of labor.

It is very simple and easy to talk and read about work as a remedy. The treatment requires infinite tact and

patience on the part of doctors, nurses and teachers. But the results are so satisfactory and so evident to all concerned that there is never likely to be any faltering, once the course is well begun. It is cheering and reassuring to know that the results of treatment are not all economic and material, that with the physical reinstatement of the patient may come a moral and spiritual reinstatement beyond all price.

CHAPTER V

Asylum Industries

WHILE the military problem of rehabilitation holds the public eye, not much will be said about the industrial possibilities of civilian cripples and the great army of the handicapped in our public institutions. I believe, however, that the experience of reconstruction hospitals and the vocational training schools will rapidly advance, the prospect of invalid occupations everywhere. There will be a large group of Occupational Aides, vitally interested in and well equipped for state hospital and asylum service after the war. There will be a clearer public understanding and a better support of any course which promises to develop and utilize the remaining powers of the handicapped. Few people who are not actually connected with the great charitable institutions know what splendid work has already been done along these lines, how much the burden of unnecessary idleness has been lifted and how promising is the future of hospital and asylum industries.

In the fifteenth annual report of the Gardner State Colony which is a Massachusetts institution for the care of the insane, Dr. Charles E. Thompson, the Superintendent, states that the money value of the farm products for the year ending in November, 1917, was \$66,614.53. He says further under the head of Industries:

The numerous industries in operation last year have been continued and in addition we have made all of our underwear on a hand-power knitting machine, and woven all blankets in a hand-loom. We are soon to begin the making of spreads on a hand-loom.

We have erected and are now equipping a building to be used as a pottery. In this we expect to make all of the crockery which we have heretofore purchased. This will be carried on as a practical industry and not so much a pottery in which artistic pottery is the aim. This is a continuation of our policy of making our industries, so far as possible, practical, of benefit to the institution and the patients themselves.

The lower floor of the women's industrial building has been equipped as an exhibit room in which samples of all articles made are on exhibition for patients and visitors. A room of this sort does much to encourage both patients and their relatives.

Cooperating in the movement for food conservation we have done far more canning and preserving at each of our departments than heretofore. Tables at the end of this report will show in some detail what industries are carried on and what the production has been. This, or any table, will not show the benefit to the patients while thus employed, but the benefit is known to be very great.

Our experience has been the more practical the industry, the more the interest of the patient, and the greater the return to the Commonwealth and the patient. This year, of the total number of patients at the colony, 94 per cent. have been employed regularly; 3.8 per cent. have been incapacitated, unable to work; 2 per cent. have been idle. Compared with the previous year (1916) there were 2 per cent. fewer employed, 2 per cent. more unable to work because of illness or incapacitated. This, perhaps, is to be expected, as our institution, receiving only by transfer, becomes older and accumulates a larger number of infirm patients.

Only extreme diligence, care and good judgment, both on the part of the physicians and employees, have prevented all but a few minor accidents, but when it is remembered that, especially in the outdoor industries, many of our patients are occupied in industries requiring the use of tools of various kinds, it is perhaps to be wondered at that we have not had more, and it may be expected as time goes on that now and again an accident will occur in spite of all precautions. When

the great benefit to the patient is considered, we are justified, I believe, in continuing our industrial pursuits just as we have carried them on in the past.

Think for a moment what this means. These unfortunate people, many of whom can never be well, are not only happier and better physically and mentally because of their occupations, but they are actually assisting in their own support, thereby lifting by just so much the already heavy load of public and family taxation. It is one of the delights of my life to visit these otherwise gloomy institutions and to see, as anyone can see, the happiness and well-being which are made possible by well-regulated industries. Years ago I saw an asylum where they had no regular occupation and I do not like to remember it except in contrast with the better conditions of today. It is within twenty years that a woman came to me for advice about her daughter who was confined in a state asylum. The girl had improved so much that she wanted something to do. The mother asked one of the nurses if she might send in some materials for making baskets as the patient had formerly been interested in such work. The nurse thought it would be all right, so the things were sent. Several weeks later, on a visit to the hospital, the mother found that the reeds and raffia had never reached the patient. The superintendent had objected because he thought that if he allowed one patient to work in this way they would all want to be doing it.

When household occupation for the insane first came into general use and wide recognition, not so very many years ago, there was opposition on the ground that it was cruel to ask these poor people to do the drudgery of the hospital work. No doubt there have been instances of abuse. The willing worker may have been overworked and harm may have been done, but many, many times the beginning of recovery has dated from the beginning of

regular, systematic work. No one now doubts the value of the expedient.

Every great state hospital is an industrial community where much of the routine work is with advantage done by the patients under proper supervision and where small manufacturing is carried out successfully and economically. If these insane patients were forced to do manufacturing for profit there might well be objection, but when they make their own clothes and shoes and enjoy doing it, objection changes to full approval or enthusiastic support. The great war with its scarcity of skilled workers will help along this good cause as nothing else could do. It will be literally necessary for the institution to employ as never before their own idle inmates.

Most of the asylums are in the country and include large farms, hundreds of acres. I do not know the figures, but probably not more than a tenth part of this acreage is under cultivation or is used for live stock. Suppose all these great farms throughout the country had gone into sheep-raising some years ago, using all available land. There would now be a very material help to the country at large in a critical time of wool shortage. I know nothing about farming or sheep, but I wish the state agricultural schools would make a survey of the institutional farms so that in a fully scientific way they might be used for the raising of live stock, sheep, pigs, goats, cows, and horses, whatever is best. The meat bills of the state could be reduced materially, and there would be more leather for shoes and harnesses. Sheepskin, wool, and mutton are valuable commodities. With the cheap labor of the asylums and almshouses, great areas could be fenced off and made dog-proof, or if this is not feasible, then the inmates, under the direction of a very few competent directors, could guard the sheep and cattle and bring them safely through to actual economic use.

Some time ago I watched with keen interest the clearing of a rocky New England pasture by the patients of an asylum. They not only picked up the small stones, but they dynamited the boulders and carried the crop of stones to a crusher which produced first-class material for road building and cement construction. I saw these same patients pouring and tamping the cement for the cellar walls of new buildings for their own occupancy. It was a sight to cheer the heart of anyone who has understood the burden of the handicapped.

When it comes to the handicrafts, as they have been employed lately in the asylums, one must understand the problem rather deeply to appreciate their justification. Surely we cannot expect a high order of craftsmanship here, among men and women whose minds no longer function truly. But it happens that a good many patients in these institutions cannot be roused to interest and effectiveness in the routine of the kitchen, the laundry or the repair shop. They must have some novelty to attract them, some bright-colored work or something to do which shows immediate and striking results. Here weaving on hand-looms comes into play. Basketry, stencilling, jig-saw work, carpentry, metal-working, these and other crafts which must, of course, be simplified, are of the utmost value. Incidentally, here as in the diversional occupations of the military hospitals, the better the quality of the work, the better the medical and moral effect upon the patient. Once the patient is aroused to interest, once he learns again to use his hands and his mind, the handicrafts may wisely be discontinued in favor of the more useful occupations of hospital service, except in those comparatively rare instances where the worker is better at a craft than he can be at anything else. Not infrequently the skill acquired in weaving or making baskets so educates and restores a patient that he becomes

with a very short apprenticeship a good painter or carpenter, a shoemaker or a tailor, working for his institution.

I suppose it is a dream beyond realization, but I have felt for many years, as I have watched the progress of useful occupations in the asylums, that some day these great institutions might be nearly or quite self-supporting. As I read each year the reports of progressive superintendents and see the rising value of things actually produced by the labor of chronic invalids, I have a feeling that the thing will be done. It will mean the employment of a good many normal people as well as all the inmates. But these mentally sick people are often quite well in body. Under competent direction they are capable of great physical effort with advantage to their minds. Here is a goal worth working for, though it may very well never be finally reached.

CHAPTER VI

The Element of Diversion

A BORED convalescent has the right to ask for diversion. We must not be so enamoured with the idea of developmental work that we forget the need of amusement. Some of us were apprehensive when the word 'diversional' was used in connection with the bedside occupations; we wanted the work to be serious, and the products to be useful and dignified. We now know that all these qualities are essential and that the most serious and ambitious work may be the best of all diversions if it is taken in the proper spirit. It has been found in Canada and abroad that when the attempt is made to force the convalescent soldiers to work and to acquire new occupations, they sometimes rebel and do such poor work that time and effort are wasted. If the bedside occupations are begun diversionally and even as sheer amusement, they may naturally run on into serious and voluntary attempts at rehabilitation. For this reason the young ladies who are to teach the bedside crafts will have a special advantage. They will be able to coax and cajole many a slacking mind and hand into saving activity where the uniformed official would fail.

We must be careful not to require a sick man to do things which would be of doubtful interest to a child. If I were a convalescent and anyone were to ask me to make a human face on an egg shell or an animal out of a raisin and some tooth-picks, I believe I would refuse with thanks and continue to refuse with emphasis, even though my instructor might be a very attractive and plausible young lady. But there are many constructive occupations which will serve as good medicine for the bored.

If we are saved the trivial and the absurd, we must not use occupations which are too serious or too hard to do.

The little hand-loom which has been devised by Mr. Frank P. Lane of Florence, Mass., deserves a very high place in the treatment of *ennui*. With it the convalescent, while still on his back, may make a great variety of interesting fabrics, hat bands, belts, neckties. If the occupational expert has taste and experience—if she has been wise enough to avail herself of the service of a good designer—the invalid occupations under her direction may be satisfactory from every point of view. The result will be happy at least in its disposal of the fatigue of boredom.

The convalescent is usually in a sad state of indecision. He feels able to do something but he does not know what to do. Whatever is proposed is likely to be rejected if the man has time to think it over. Therefore it is necessary to be prepared with materials and ready to put them into immediate use. If you say to the patient: "Wouldn't you like to braid a rug this morning?" an emphatic "no" may be your answer and the answer you deserve. Of course he does not want to braid a rug—what could be more silly and footless. But put the cloth into his hands, show him how, and he will braid with enthusiasm and profit.

I have been experimenting lately with jig-saw work as a convalescent occupation. Not the old-fashioned scroll work, not the making of little impossible brackets for dusty corners. Most people think of jig-saw work as hopeless, as forlorn—terminating at last in the perpetration of a little highly ornamented cuckoo-clock that will not go and which falls to pieces when the glue dries up. I do not mean even the popular picture puzzles though they have a good deal of justification. One of my patients, an artist, has designed a lot of toy animals to be made of wood and painted. If these toys were commonplace

I should expect them to fail and to serve only a very limited use. But they are delicious caricatures, they are highly conventionalized animals that charm with their freshly painted stiffness and paucity of detail. They have, in the vernacular, punch and go. A man who has fair muscle may saw them out on a bedside bench. If the muscle is lacking the attendant may do the sawing. The patient can apply the paint. We have discovered a paint which does not smell of turpentine. It is a water color, a 'Show Card' paint so-called, made by the Devoe Manufacturing Co. It may be varnished over at once without making the colors run. It is a boon to the convalescent worker. Imagine the delight of painting with bright red spots a purple pig so cleverly modeled that you almost hear him grunt and yet so ridiculously simple in decorative treatment that no one may look upon him without a smile.

Such occupations do not grow, they are the result of careful thought. No one who has not had rigid artistic training or who is without imagination and humor may ever design such a pig as I have described. Caricature is as truly an art as the painting of portraits. But there are people who can design such animals and they should be asked to do it for the benefit of handicapped workers. When all is ready and there is no chance of failure, then the materials may be given into the hands of the convalescent.

I am quite sure that amusing occupations, if they are not sloppy kindergarten makeshifts, have a very valuable place in the scheme of invalid occupations. I have preached the serious pursuits always and I believe in them, but sometimes diversion must come first, even if the patient will not be long satisfied with it. Once on his way, once sure of himself, we may depend upon the natural good will and good sense of the average convalescent to carry him forward into the field of real work.

**Publications of the Red Cross Institute for
Crippled and Disabled Men**

Edited by Douglas C. McMurtrie

Series II

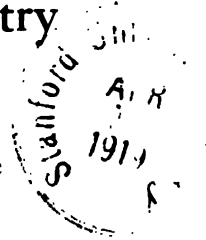
March 10, 1919

Number 6

**Employment Opportunities for
Handicapped Men in the
Optical Goods Industry**

By Bert J. Morris

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Prepared by the
Bureau of Vocational Guidance
In Cooperation with
Red Cross Institute for Crippled and
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Opportunities for Handicapped Men in the Optical Goods Industry

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Weighing glass for lenses

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Foreword

THIS report on the optical goods industry is one of a series of occupational studies prepared by the Harvard Bureau of Vocational Guidance for the purpose of making available information concerning possible openings for handicapped men. It is the result of a survey of a considerable number of optical manufacturing establishments and prescription shops in New England. Preliminary reports of individual establishments have been placed in the hands of the Federal Board for Vocational Education, The United States Employment Service, and The Vocational Training Division of the Massachusetts Industrial Accident Board, and other agencies interested in the rehabilitation of handicapped persons. In its present form, the report deals with the optical industry in general rather than with any particular establishment, and is published in the hope that it may be of service in the work of restoring to civil and industrial life those who have been injured either in war or in industry.

Opportunities for Handicapped Men in the Optical Goods Industry

Much has been said in the public press about the advantages for disabled men in optical manufacturing establishments. Employers have reported to government officials and to other agencies interested in the rehabilitation of disabled soldiers and sailors that they could offer suitable occupations for practically all types of handicaps except cases of blindness and the loss of the use of the fingers. A careful study of typical plants has brought to light information which justifies these reports in the press and on the part of employers. Some of the principal advantages are as follows:

1. *Light Bench Work.* The making of frames for eyeglasses and goggles offers a large variety of occupations which are done while the worker is seated at a table. The work is light and varied so that interest is easily maintained.

2. *Attractive Working Conditions.* The materials used, such as gold, white metal, tortoise-shell, and steel, are such as to make it possible to keep the working rooms in a clean, attractive condition. No health hazards are introduced by the materials used. As one passes through the establishment, the factories appear more like offices than workshops. This feature is a strong factor in promoting contentment and satisfaction among the operatives.

3. *A High Class of Workers.* The nature of the work and the condition of the factories induce a high class of persons to take up the work. Men and women who are not disposed to work in factories where the materials are necessarily dirty and offer numerous health hazards are often content to work in optical establishments.

4. *Steady Employment.* The manufacture of optical goods offers steady employment the year round. There are no periods of depression or slumps in the industry so that one can count on regular employment. Perhaps no other line of industry is as free from slack periods as is this industry.

5. *A Growing Industry.* During the last few decades, the optical industry has grown very rapidly. The careful supervision of the health of pupils in the public schools has led to extended use of glasses on the part of pupils. The discovery of the fact that many of the physical ailments of pupils are due to defective sight is leading adults also to recognize that weak or defective eyes are the causes of many of their ailments which heretofore have been attributed to other causes. It is estimated that about seven persons out of ten would profit by the use of eyeglasses, while, at the present time, not more than two in ten are using them. The trend of events indicates that the industry will have to expand very rapidly to supply the increased demand for glasses. Leading establishments are making plans to meet an unusual expansion of business as the country returns to the normal conditions of peace.

American optical goods are fast winning their way in all foreign markets. The export trade offers one of the most promising fields for future development. In 1910 more than ninety per cent. of the spectacles, eyeglasses, and ground or finished eyeglass and spectacle lenses and ninety-five per cent. of the spectacle and eyeglass frames used in Canada were imported from the United States. The leading firms in Mexico City state that they buy practically all of their spectacle frames and lenses in the United States because of the better quality of goods for the price and the quicker deliveries. In speaking of the European trade, Consul General Frank H. Mason of Paris says: "The dominant fact that pervades the whole subject is that while French and German makers of optical glass and lenses are unsurpassed, if equalled, by those of any other country, the Americans are far superior as

mechanics in skillful construction, shaping, and adjustment of springs, studs, guards, and frames with which they are equipped." Before the war, the American style of pincenez, consisting of glass without rims, was very popular, even in Vienna, the internationally renowned city of eye specialists.

In Paris, the American goods are very popular at the present time because of the so-called gold-filled mountings made of a combination of metals which resembles gold, takes a polish, has the strength and elasticity of steel, and does not tarnish in the presence of moisture. American goods of this kind are so popular in Paris that a number of European firms have endeavored to imitate them and sell them under the name of American goods. In Switzerland, the American frames are very popular though lenses are, for the most part, imported from France and Germany. Before the war, American goods were finding their way into Sweden in large numbers but almost wholly through German houses. More than twenty per cent. of the frames and from twenty to twenty-five per cent. of the lenses used in London before the war were imported from the United States.

Manufacturers of optical goods are of the opinion that the foreign field is much more promising now than before the war. When it is understood that American products were considered superior to foreign goods even before the war, it is only reasonable to expect that the foreign trade will increase rapidly as we return to a peace basis of commerce.

Another field in which material progress has been made since the beginning of the war is in the manufacture of goggles. This is due largely to the increased use in recent years of automobiles and motor-cycles as well as the still more recent development of aeronautics. These new fields are impelling opticians to pay much

more attention to the manufacture of a high quality of goggles. With large openings in the foreign field and the increasing use of glasses of all kinds, the optical industry seems to be entering upon an era of unparalleled expansion.

Most of the advantages mentioned above apply especially to the manufacture of frames and cases. Prescription work offers other advantages, a few of which are mentioned in the sections that follow:

1. *Wide Distribution of Shops.* Prescription shops are found in large numbers in practically all towns and cities of any considerable size. This is a decided advantage from the point of view of disabled men as it offers opportunities for the employment of large numbers of men close to their own homes.

2. *Openings for Inexperienced Workers.* Many of the operations are open to beginners without previous experience. These positions pay good wages and at the same time offer opportunities for the workers to become acquainted with the various operations in the entire shop.

3. *The Work is Free From Monotony.* Each operation involves a number of details, which lessens the monotony that is so often connected with operating mechanical machines. Hundreds of different styles of lenses are necessary to meet the demands of the prescription trade so that a worker employed at the same operation is called upon to do many different kinds of work during the day.

4. *Opportunities for Advancement.* The different operations naturally fall into a progressive order of development which enables a worker to advance from one task to another as skill and experience are developed. For instance, employers prefer to take young men to learn the work. They start them as messenger boys, which brings them into touch with all the different departments and enables them to form a clear conception of the work as a whole. From messenger boys, they advance naturally to the work of laying out and, from this, to polishing, grinding, hand edging, and final inspection. A worker who understands the different steps in the manufacture

of articles usually becomes more loyal to the establishment. Labor turn over is considerably reduced by this progressive training of employees.

The work in the manufacture of eyeglasses and goggles naturally falls into three divisions: The manufacture of lenses, the manufacture of frames, and optical prescription work. A few large factories are equipped to do work in all three lines, though most of the prescription work is done in small factories scattered throughout the country.

THE MAKING OF LENSES

Though a large number of operations are involved in the manufacture of lenses, they fall into a few natural divisions. For the purposes of this report it will be necessary to consider only these divisions and not to take up the separate operations in detail. The main divisions are as follows:

1. Preparing Glass Stock.
2. Rough Edging Lenses.
3. Blocking-On.
4. Surface Grinding.
5. Polishing.
6. Picking-Off.
7. Washing.
8. Testing and Gauging.
9. Packing and Shipping.

Preparing Glass Stock. Glass stock comes to the factories either in large sheets or in huge rough chunks. The glass that comes in sheets is cut in convenient sizes for surface grinding. Glass that comes in blocks is broken and weighed into amounts as is required to make the different sizes of lenses. The weighing is usually done on common balance scales; a lens is placed on one side and enough glass to balance it on the other. After the glass has been weighed, it is put into molds and fused into shape.

The worker must be able to read simple instructions and to keep accurate records of the lenses weighed. As

about the average man can learn it in the work in two or three weeks though it takes a much longer time to be able to earn the highest wages. The work requires a considerable amount of walking and lifting, which means that the operator should be fairly free from serious handicaps. Some foremen are of the opinion that a man who has lost a leg below the knee would be able to do the work without loss of efficiency. Defective hearing, the loss of one eye, or the loss of two or three fingers, would not interfere with efficient work. Wages range from \$14 to \$20 per week.

Grinding Edging. During the process of making some of the glass rods over the edge of the mold and forms in rough strips around the lens. This is removed by use of a compressing stone. The lenses are held on the stone by the hand and persons who are experienced can often grind 1,000 or 2,000 lenses in one day. The work requires deftness of finger movements rather than strength. Most factories employ boys from fourteen to sixteen years of age at this operation. They receive \$9 per week at the start and after a few weeks' experience many of them earn as high as \$25 on piece-work. The work could be done while the operator is seated, though most of the boys prefer to stand. The loss of a leg below the knee, defective hearing, the loss of one eye, hernia in a mild form, or slight trunk injuries would not incapacitate one.

Blocking-On. Blocking-on is a term applied to the work of putting the lenses on a proper block in preparation for the work of grinding. In most factories this work is done by molding concave and convex blocks out of earthen material to the desired size and shape, covering them with hot pitch, and, as the pitch cools, placing lenses in it in rows at regular distances. When the pitch hardens, the block is ready for the grinding machine. The work is not suitable for handicapped men though it would be

possible for one who had lost two or three fingers or a leg below the knee to do the work without loss of efficiency. As a rule, it takes a worker two or three weeks to become handy at this operation. Wages range from \$18 to \$22 per week.

Surface Grinding. Lens factories usually surface lenses on one side only and leave the other side to be finished in prescription shops. This is due to the fact that eyes vary so widely in their defects and power of vision that standard styles can be made only in a very general way. These standard styles must be made so that they can be easily adapted to the peculiar conditions of the eyes of each customer.

For surface grinding modern factories have machinery by means of which one operator can grind a thousand or more lenses at one time. The machines consist of a row of upright spindles attached to one long shaft. The upper end of the spindle is made so as to receive tools of different sizes and shapes. The chief work of the operator is to set the tools and keep them supplied with an emery composition during the process of grinding. Convex lenses are stuck on large convex blocks; concave lenses on concave blocks. The blocks hold from fifty to one hundred lenses, according to the size of the lenses. For grinding convex lenses concave tools are used and vice versa. The block fits into the tool just as the bottom of a saucer fits into the top of another saucer. Automatic appliances are attached to the machine which hold the blocks firmly against the tool as the latter is in motion. The emery composition grinds the lenses into shape but leaves them with rough surfaces.

The work involves a considerable amount of walking and lifting so that the operator must be fairly able-bodied, though one who had only a stump of a hand would be able to do the work without much loss of efficiency.

Defective hearing, the loss of one eye or the loss of three or four fingers would not incapacitate one. As a rule, operators of surface-grinding machines begin work as polishers and are advanced to surface grinding only after they have become skilled at handling polishing machines. It takes an average man six months or more to learn surface grinding and a much longer time to be able to earn the highest wages. Some of the most skilled men make as high as \$35 a week.

Polishing. Polishing lenses is done on the same kind of a machine as grinding, the only difference being that rouge is used instead of emery. The work is simple and can be learned in two or three months. Wages are practically the same as for grinding and the operation bears the same relation to handicaps.

Picking-Off. After the lenses have been surfaced on one side they are removed from the block. This work is known as picking-off and is done by holding a block in cold water until the pitch becomes chilled, when the lenses are easily picked off by hand or with a tool similar to a screw-driver. The work is wet and heavy and not suited to men with serious handicaps, though defective hearing, the loss of two or three fingers, or one eye would not interfere with efficient work. Men receive \$18 at the start and after a few months' experience make as high as \$22 a week by piece-work.

Washing. After the lenses have been picked off they are taken to large tanks, usually four in number, to be washed. The first tank contains a weak solution of acetic acid; the second one, hot water; the third tank, another solution of acid; and the fourth one, cold water. New men can begin the work immediately and in a few weeks are able to earn full pay. This work is not desirable for handicapped men. Wages range from \$18 to \$20 per week.

Testing and Gauging. After the lenses are thoroughly washed they are tested for curvature and gauged for thickness. This work is done by means of a very simple lens-measuring instrument and while the worker is seated at a table. The work can be learned in a few weeks' time, and offers suitable opportunities for men who have lost a leg above the knee, the loss of three fingers or less on one hand, defective hearing, trunk injuries, or hernia. Persons who have been gassed or who have recovered from shell shock would find this work very satisfactory. Wages average about \$20 per week.

Packing and Shipping. Some of the lenses go from the testing-room to the prescription-room while others are packed to be shipped to customers. Packing is light, clean, attractive work. It is usually done by women. It consists of putting each lens in an envelope and tying the envelopes together in packages of one dozen each. The principal qualifications are deftness of finger movements and keenness of eyesight. Experienced women are able to make from \$15 to \$20 a week at piece-work. The work could be done by men who had lost a leg or who had received serious trunk injuries.

MAKING FRAMES AND CASES

Frames for eyeglasses are made of steel, celluloid, tortoise-shell, white metal, filled gold, and solid gold. The work involves a very large number of separate operations which are not easily classified into typical classes. For the purpose of this report we will group the work under the following headings:

1. Light Press Work.
2. Bench Machine Work.
3. Hand Work.

All three kinds of work are involved in the making of frames regardless of the kind of material used. In what

follows, therefore, nothing will be said as to the nature of the material.

Light Press Work. The work of blanking out eye-pieces, screen binders, end pieces, cutting temple pieces, and forming bridges is done on machines, usually spoken of as 'A' presses, since the frame is shaped like the letter 'A'. Compared with the press work in machine shops and shoe manufacture this work is comparatively light. Operating the machines may usually be done while the operator is seated. The average person could learn to operate a press satisfactorily in two or three weeks' time, though a longer experience is necessary in order to earn the highest wages. Some of the presses are operated by treadle and some are operated by hand. Treadle presses offer suitable work to men who have lost a leg either above or below the knee, or who have received trunk injuries. There is nothing in the work that would be injurious to a person with arrested tuberculosis. Presses arranged to be operated by hand offer suitable opportunities to legless men as well as the handicaps mentioned above. Wages range from \$22 to \$25 per week. Modern shops have a large number of heavy presses and are in a position to offer desirable work to a considerable number of handicapped men. A foreman of one of the leading establishments in New England affirms that they can find work for men with any kind of handicaps except blindness and the loss of the use of the fingers.

Bench Machine Work. The work on solid-gold frames, gold-filled frames, steel frames, and gold finger-pieces involves a number of different operations for which single purpose machines have been especially designed. Most of these machines are light bench presses and can be handled easily by women. Skill in repetative finger and hand movements, rather than physical strength is required for efficient work.

Working on gold and white metal is clean, attractive work which draws a high class of employees. As one passes through the plant, the workshops appear more like offices than factories.

The operator of a single purpose machine must learn the work in the shop. To establish a vestibule school would require about as many machines as are found in the main factory, as one machine usually does all of the work of one kind. Women seem better adapted to this kind of work than men, though some establishments employ the latter in considerable numbers. The loss of one or both legs, trunk injuries, or hernia would not interfere with efficient work. The working conditions are such that arrested tuberculosis would not debar one from this operation. It is difficult to make any definite statement in regard to the time required to learn the work. Some of the operations require a much longer time than others and people differ in their ability to learn to operate the single purpose machines. It is safe to say that it would take an average person two months or more to become an experienced worker. Wages differ very greatly. Some operations pay from \$10 to \$12 while others pay as high as \$25 per week.

Hand Work. Assembling the various parts of eyeglasses and goggles offers employment to a large number of workers. Handling the small parts like screws and eye-pieces is tedious work for which women seem better adapted than men. The work is very light but requires extraordinary deftness of finger movements and keenness of eyesight. The work is brought to the assembling table by the service boys so that the worker is seated all day long. For men who have had experience in watch or jewelry-making, this operation offers very attractive opportunities. Employers of leading establishments are willing to employ handicapped men at assembling work and will

give them a fair trial in order to see if they can do the work satisfactorily. It is safe to say that anyone who is adapted to fine hand work of this kind would be able to find work which he could do. Good wages are paid to beginners, and workers who are quick and accurate can earn by piece-work \$25 or more per week.

Cases. Cases for single pairs of glasses are made of steel, leatherette, leather, and white metal. The work is done on presses while the operator is seated. No heavy lifting is required so that men who have serious injuries to the legs or trunk organs would find the work very satisfactory. Quickness of movement rather than muscular strength is required. Men and women are employed in about equal numbers. Some employers are anxious to try handicapped men on this work. They are of the opinion that men who have lost a leg, a hand, or who have received serious muscular injuries could be fitted into positions where they would make good wages. The conditions are such that men who have been gassed or who have arrested tuberculosis might find the work satisfactory. Some foremen make the sweeping statement that they could place men with any kind of a handicap save the loss of the use of most of their fingers or blindness. Wages vary greatly; some operations pay as high as \$28 or \$30 while others pay as low as \$12 to \$15 per week.

Packing and Shipping. Gold-filled and solid-gold frames are, as a rule, packed in individual packages and shipped by parcels post. Other frames and cases are carefully wrapped and packed in cases containing several dozen pairs. The work of wrapping and packing is done, as a rule, by women who receive from \$12 to \$15 per week. The only operations at which men work are those of handling the cases and helping store the packages on the labeled shelves which often extend nearly to the ceiling

of the store-room, hence the work of packing offers very little opportunity to handicapped men.

PRESCRIPTION WORK

Optical companies which do prescription work are found in considerable numbers in all large cities, and branches are located in smaller cities and towns throughout the country. The prescription optician is becoming about as necessary as the pharmacist. And just as the latter fills the medical prescriptions to order, so the former fits glasses to order. The work involves a number of operations, the most important of which will be treated in the following sections.

Laying Out. The first operation in connection with prescription work is the selection of the lenses to fill the orders received for the day. This work is done in some shops by women and in others by men. It consists, first, in taking the orders as received and writing them out in the technical language of the shop; and second, in selecting the proper lenses to fill each prescription. Sometimes the person who does the work of laying out gives directions to other workers in the plant. When this is the case, the one who does the work of laying out is the foreman of the grinding department. Combining the work of foreman with laying out requires that the employee should be fairly able-bodied. He must move about the room constantly and be able to assist new men in their work.

When, as is frequently the case, one person works at laying out only, the operation offers suitable opportunities for one who has lost one or both legs as the work can be done seated at a table. Deafness, weak kidneys, hernia, or arrested tubercular trouble would not interfere with efficient work. Two arms, two hands, and not less than

eight fingers are necessary for satisfactory work. Wages range from \$10 to \$18 per week.

Blocking-On. The work of blocking-on consists in fastening lenses to metal blocks in preparation for grinding. For this purpose Burgundy pitch is used, which not only fastens the lens firmly to the block but forms an opaque background which enables the operator to note any defects in the work of grinding. Wages are from \$8 to \$10 to start, and experienced men make from \$20 to \$22 per week by piece-work. The loss of three or four fingers, one leg, deafness, weak kidneys, or hernia would not be serious handicaps. The opportunities for advancement to grinding and polishing are good, and men who show an interest in their work are usually advanced to other positions in three or four months.

Grinding. The work of grinding lenses to the proper thickness and curvature is done on simple machines, which consist of a vertical spindle with an appliance by which different tools may be used. Each style of lens must be ground on a tool made especially for that kind of lens. Convex and concave lenses vary all the way from .12 of a millimeter to 26 millimeters in diameter.

The work of grinding consists in holding the lens firmly and evenly on the tool as the spindle is in motion. This is done by means of a lever fastened to a frame which projects seven or eight inches above the top of the tool. A steel pin is set in the lever so as to be easily brought into place directly over the spindle. By taking the lever in one hand the worker can press down on the lens with as much force as is necessary to grind it properly. As was mentioned in the discussion of the manufacture of lenses, an emery composition is used for grinding purposes. It is moistened with water and constantly applied to the tool as the machine is in motion.

The only educational qualification required is that one be able to read simple instructions. It takes the average person six months or more to learn the operation. The work can be done while the operator is seated, though most workers prefer to stand at least part of the time. A man who had lost one or both legs would be able to do efficient work without difficulty. Two arms are probably required, though the loss of one arm below the elbow might not be a serious handicap providing the person had a suitable appliance. If an operator has lost one arm below the elbow, the other hand should be practically perfect in order to adjust the tools without loss of time. Deafness, weak kidneys, or hernia would not incapacitate one. Normal lungs, healthy skin, and good eyes are necessary for this work. Wages range from \$15 to \$23 per week.

Polishing. After the lenses have been ground to the desired thickness and diameter they are taken to polishing machines where all rough scratches are removed from the surface of the lens. These machines are very similar to grinding machines though rouge is used instead of emery. Polishing is not as difficult to learn as grinding, so, as a rule, workers advance from blocking on to polishing and from polishing to grinding. The average man can learn polishing in three or four months, but, as a rule, it takes a year or more to earn the highest wages. The work bears practically the same relations to handicaps as that of grinding. Wages range from \$15 to \$20 per week.

Automatic Grinding and Polishing. Descriptions of grinding and polishing as given above apply to the work on plain and spherical lenses. Toric or cylindrical lenses are ground on automatic machines which are quite complicated in construction but made so as to need little care while in operation. They differ primarily from the

spherical grinding machines in that the hand lever of the latter is replaced by an automatic appliance which holds the lens on the tool. The appliance is so constructed as to give a double motion to the lens which is necessary in order to finish it with two curvatures of unequal radii on the same surface. The purpose of the toric lens is to overcome the astigmatism of the eye. This is done by grinding the outer part at a sharper curvature than the inner part of the lens.

One operator can care for five or six machines. The principal work is to keep emery on the tools and to see that the automatic arm is properly adjusted. The average person can learn to operate the machine in three or four months. The worker recognizes by the sound whether or not the machines are working properly, hence normal hearing is a necessary qualification. The loss of a leg, an arm, a hand, or three fingers or less on one or both hands would not incapacitate one. On account of the fact that the work is wet and dirty, it is not suited to men with lung trouble or skin diseases. Wages vary in different plants and range from \$15 to \$22 per week.

Picking-Off and Washing. After the lenses have been polished they are placed in cold water which chills the pitch and makes it possible to remove the lens from the block without injury to the lens. After the lenses are removed from the block, they are washed through a weak solution of acid and rinsed in clear water. Sometimes it is necessary to use benzene or alcohol to remove all traces of the pitch from the lenses. A new man can take up the work immediately and within a few days' time be able to earn from \$18 to \$20 per week. The loss of a leg either above or below the knee, a stump of a hand, defective hearing, trunk injuries, or hernia would not interfere with efficient work.

Testing and Gauging for Thickness. After the lens has been washed it is tested for power and gauged for thickness. Most plants employ women for this work. The wages range from \$10 to \$15 per week. The inspector must know whether the lens is of uniform curvature and thickness. For measuring curvature a simple tool is used, which consists of a round case about the size of a watch supporting three points in a straight line. The outside points are stationary while the middle one is movable and attached to a needle which indicates the diameter as the point follows the surface of the lens. The work can be learned in a few weeks and pays from \$10 to \$15 per week.

Lining Up. The lenses that pass inspection are taken to another operator who marks on the lens the optical center and draws a line indicating the axes of curvature. This is done by simple instruments which the average person can learn to operate in a few weeks' time. The work is done at a table and offers splendid opportunities for legless men or men who have defective hearing, trunk injuries, arrested tuberculosis, paralysis, or hernia. Some companies employ girls at this operation. Wages range from \$10 to \$12 per v

Cutting. ~~After the lenses have been lined up, they are~~ cut to approximately the desired size and shape. This is done on machines with diamond cutters. The lens is held firmly on a revolving plate which is adjusted so as to move underneath the stationary diamond cutter in such a way as to cut the lens according to the shape desired. The lens is cut about half-way through by the diamond cutter and then broken off the rest of the way by means of hand pliers. This work is not difficult and may be learned by the average person in two or three months' time. The operator is seated at a table so that the loss of one or both legs would not be a serious handi-

cap. Two arms, two hands, and at least six fingers are necessary for rapid work. Deafness, trunk injuries, or hernia would not interfere with satisfactory work. Wages range from \$12 to \$20 per week.

Drilling. Lenses which are to be mounted without rims must have holes drilled in them to receive the screws by which the finger-pieces are fastened on. For this work small drilling lathes are used. Different styles are found in different plants but the usual style is a lathe with an upright drill which works in contact with a round table. The function of the table is to support and hold the lens firmly during the operation. A device is attached to the table which enables the operator to adjust the different styles of lenses to the lathe without loss of time. In some shops the man who does the cutting does the drilling also. The operation pays the same wages and bears the same relations to handicapped men as that of cutting.

Automatic Edge Grinding. After the lenses have been cut to approximately the desired size, they are put on automatic grinding machines, which grind them to the exact size. These machines consist of a lathe adjusted to a grindstone. Appliances are arranged by which the lens can be set on a pattern which determines the extent to which the lens may be ground. When the lens is ground to the same size as the pattern the grinding automatically ceases.

The average employee can learn to do the operation in three or four months. As one man takes care of several machines, a considerable amount of walking is necessary. For this reason injuries to the lower extremities, while not incapacitating one, would probably interfere with satisfactory work. The loss of two or three fingers on either hand, defective hearing, trunk injuries, or hernia

would not interfere with one's efficiency. Wages range from \$10 to \$20 per week.

Hand Edge Grinding. After the lenses come from the automatic grinding machines, the edge is rounded if the lens is to be mounted without a frame and beveled if mounted in a frame. The work is done by hand and requires the deft use of the fingers. The loss of one leg, defective hearing, trunk injuries, hernia, or arrested tuberculosis would not interfere with efficient work. Wages range from \$15 to \$23 per week by piece-work.

Mounting. From the hand-edging machine the lenses go to the mounting-room where the lenses are set in frames or on finger-pieces. The worker is seated at a table so that the loss of one or both legs would not be a handicap. The use of both hands is necessary though the loss of one or two fingers would not be serious. Deafness, trunk injuries, hernia, or arrested tuberculosis would not interfere with satisfactory work. Women receive from \$10 to \$18 per week while men average from \$18 to \$22 per week.

Final Inspection. From the mounting table the lenses go to the final inspector. This work consists in testing lenses for uniform thickness, focusing power, and proper mounting. Testing lenses for focusing power is sometimes done by testing machines but usually by comparison with standard lenses. In the latter case the inspector takes a standard lens and looks through it at an object in the room and then looks at the same object through the lens which is being tested. If the result is the same, the lens is passed. Inspecting requires long experience as inspectors must be perfectly familiar with good workmanship in connection with the frames as well as with the lenses. A person, as a rule, must have worked in the shop two or more years before he can be a final inspector. As the work is done while the operator is seated at a table, the loss of one or both legs would not be a handicap. Two

hands are necessary though the loss of two or three fingers would not interfere with good work. Men inspectors receive from \$25 to \$27 per week.

Washing and Wrapping. After the glasses pass the final inspector they are washed in a disinfectant solution and each pair is wrapped separately for shipping. Even when the customer orders cases as well as glasses the two are packed and mailed separately as the glasses cannot be packed safely for shipping in cases. In most shops women do the work of washing and receive from \$10 to \$12 per week.

Mailing. As most of the work of the prescription shops is the filling of individual orders, glasses are, as a rule, mailed in single pairs. The work of mailing is light and offers suitable employment for men who have lost an arm, a leg, or who have defective hearing, trunk injuries, hernia, or arrested tuberculosis. Most plants at the present time employ women at this operation, and wages range from \$12 to \$25 per week.

BIFOCAL LENSES

A bifocal lens is one that has two focusing powers. This may be secured in one of two ways: First, by cementing a small lens with a different focal power to the lower part of the lens; and second, by fusing a segment on to an ordinary lens. The bifocal lenses made according to the last method are called kryptoks.

Several of the operations involved in making kryptok lenses are very similar to those described under the making of spherical lenses. They will be enumerated in this discussion, however, so that the complete process of making kryptoks may be clearly seen.

Laying Out. This operation is the same as the laying out of spherical lenses though, as a rule, it is done by the one who specializes on kryptok lenses.

Blocking-On. The large lens is fastened on to a small block which enables the operator to grind a small hole in the lower part of the lens rather than to surface the entire lens. The hole is made a little larger than the segment which is to be fused on to the large lens. While the work is very similar to that of spherical lenses, it is more particular and requires a worker of considerable experience.

Grinding Hole. The first step after blocking on is to grind a hole in the large lens which is to receive the segment. The work is done on a machine similar to those used in the spherical department but with tools adapted to this special work. It requires six months or more for one to be able to do this work.

Picking-Off. After the hole has been ground to the proper depth, the lens is placed in cold water which chills the pitch so that the lens is easily removed from the block. The man who does the picking-off usually washes the lens, using for this purpose a mild solution of acid or benzene.

The operations mentioned above are done in most shops by the men who work on spherical lenses. They, therefore, bear the same relation to wages and handicapped men as the same operations described in the discussion of spherical lenses.

Fusing Kryptok Lenses. For the purpose of fusing the segment on to the large lens small fusing furnaces are used. These consist of brick ovens encased in metal coverings and heated by a gas flame. The large lens must be carefully cleaned and dried before the segment is set in place. The heat is turned on gradually and, after the segment, which is composed of softer glass than the large lens, melts sufficiently to just begin to run, the operator moves it back and forth in the hole so as to expel all air from between the two lenses. After this is done, the heat is gradually increased until a temperature of from 1200

degrees to 1300 degrees Fahrenheit is reached. This temperature is maintained until the small lens melts enough to run over the edge of the large lens. The heat is then turned off and the furnace is closed tightly and the lenses are left to cool gradually in the furnace. To remove the lenses before they are well cooled would, in most cases, result in impairing their efficiency. It takes from five to six hours' time to fuse one set of lenses.

This work is light and attractive and could be done by one who had lost a leg or an arm. Trunk injuries, hernia, defective hearing, the loss of one eye, or stiffness of joints would not seriously handicap one. Wages have not been standardized but foremen will gladly state the wages which are being paid at the present time on application.

Grinding and Polishing. After kryptok lenses have been fused, they are ground on ordinary grinding machines until the surface of the part fused on is perfectly smooth with the larger lens. The curvature of the fused part is exactly the same as that of the lens proper; the difference in power is due not to difference of curvature but to a difference in the quality of the glass. As the segment is made of softer glass than the lens proper, it is of a stronger focusing power.

Kryptoks are more expensive than cemented bifocals though they are, no doubt, much more durable.

Opportunities for Handicapped Men. As the number of workers employed in making kryptok lenses is very small in proportion to the whole number of workers in optical manufacture, the opportunities for handicapped men are few in number. A disabled soldier who has had previous experience in optical manufacture would find that work in connection with kryptoks offers desirable opportunities. Handicaps of all types except the loss of the use of fingers and blindness would be able to do the work without loss of efficiency.

Operations as Related to Disabilities in the Manufacture of Optical Goods

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Receiving room for glass stock



*Mixing emery compounds. At the left is the machine used for
different grades of emery*



Removing rough edges from milled timbers



Blocking lenses. Lenses are fastened to concave or convex blocks with pitch which is contained in the large suspended tanks



Washing lenses



Cutting out leather for spectacle cases. Safety guards eliminate practically all risk of accidents



Drilling holes. Lenses to be mounted without frames have holes drilled near the edge for finger and temple pieces



Inspecting lenses



Cutting out small parts. Bench presses used in cutting out small parts for spectacle and eyeglass frames



Operating hand edge grinding machines



Making and polishing steel parts for eyeglasses and goggles



Making shell-ware frames



Drawing gold wire for spectacle and eyeglass frames



Mounting finger pieces



Assembling goggles



Embossing monograms on lenses



The dictaphone section of the office. This represents about the only type of position open to the blind

1. The first part of the document is a list of the names of the persons who were present at the meeting.

2.

3.

4.

**Publications of the Red Cross Institute for
Crippled and Disabled Men**

Edited by Douglas C. McMurtrie

ies 11

May 1, 1919

Number 7

**Opportunities for Handicapped Men
in the Brush Industry**

By Charles H. Paull

Bureau of Vocational Guidance

Division of Education

Harvard University



Prepared by the
Bureau of Vocational Guidance
In cooperation with
Red Cross Institute for Crippled and
Disabled Men, New York

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311 Fourth Avenue New York City

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Opportunities for Handicapped Men in the Brush Industry

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The Brush Industry

Foreword

THIS report is the result of one of a series of investigations made by the Harvard Bureau of Vocational Guidance. It represents a survey of several representative plants made by the author and others who visited the manufacturing departments and studied all of the processes involved. The material presented is intended to be helpful to vocational counselors and placement agents as well as to crippled men who wish to inform themselves regarding the occupational opportunities in industry.

The aim in this report has been to give a general idea of the processes involved in brushmaking. Unlike some industries, there is a great variety in detail of method in the making of brushes. Companies have developed special methods of their own for carrying on certain processes and, to some extent, desire to keep these methods for themselves. It has, therefore, been impracticable to suggest all the various phases of brushmaking. The effort has rather been to follow through the process logically, describing as nearly as possible characteristic operations. In attempting to place handicapped men, it will be found that the discussion in this report will give a sufficiently definite idea of the character of the work involved, though the details may be somewhat different in different communities.

As has been suggested in the Bureau's report on the rubber industry, it is impossible to say definitely that all men with certain handicaps can engage successfully in

all the operations suggested for those handicaps. The element of individual differences in men, and the sympathetic assistance which they may receive, naturally play a very important part in their future in any employment.

The making of certain unusual forms of brushes, such as those used in certain textile operations and patented wire brushes, has not been taken up in this report. Because the making of these brushes is comparatively limited and because a number of the operations are similar to those described in connection with the making of other brushes, it has not been deemed advisable to take added space for a separate discussion.

Opportunities for Handicapped Men in the Brush Industry

Brushes and Brushmaking. There is some doubt as to the origin of the word brush. Some authorities maintain that the word developed from the fact that primitive brushes were made from brush wood. It is more probable, however, that the word developed from the same root as the German word *borste*, which means bristle.

The use of brushes dates back to very early history. The brush or broom is mentioned in Homer. In later history the brush appeared in the broom of the housewife and of the chimney sweep. In modern times the brush has developed in a great variety of forms to fit particular needs.

Before the opening of the nineteenth century, England supplied most of the brushes used in this country. During the War of 1812 domestic brushes began to supersede those which had previously been imported. One of the earliest brush factories in this country, of which we have record, was established in Massachusetts. The lead which Massachusetts obtained by entering the field in the early history of the industry is still maintained, although New York state is at present a close rival. Other states manufacturing brushes to an important extent are Maryland, New Jersey, Ohio, Illinois, and Pennsylvania.

The Development of Brush Factories in the United States. Like all other industries of early origin the making of brushes was confined to hand operations. Small establishments grew up here and there in the United States. Some of the work was done in the shop and some was taken home to be done by housewives and children during

leisure time. The custom of sending work into the homes has largely disappeared in the United States at the present time, partly as a result of labor legislation and partly because it has shown itself to be non-economic. The tendency for the work to be done in small factories is, however, still very evident. The Table below showing the average number of wage earners per establishment in the United States from 1849 to 1914 demonstrates how the small plant has remained in the field. In the 65 years between these dates there has been an average increase of only four wage earners per establishment, and if we take the figures for 1859 there would be an average increase of only one wage earner per establishment. It is probable, however, that between 1914 and the present time there has been a further increase in the average wage earner per establishment.

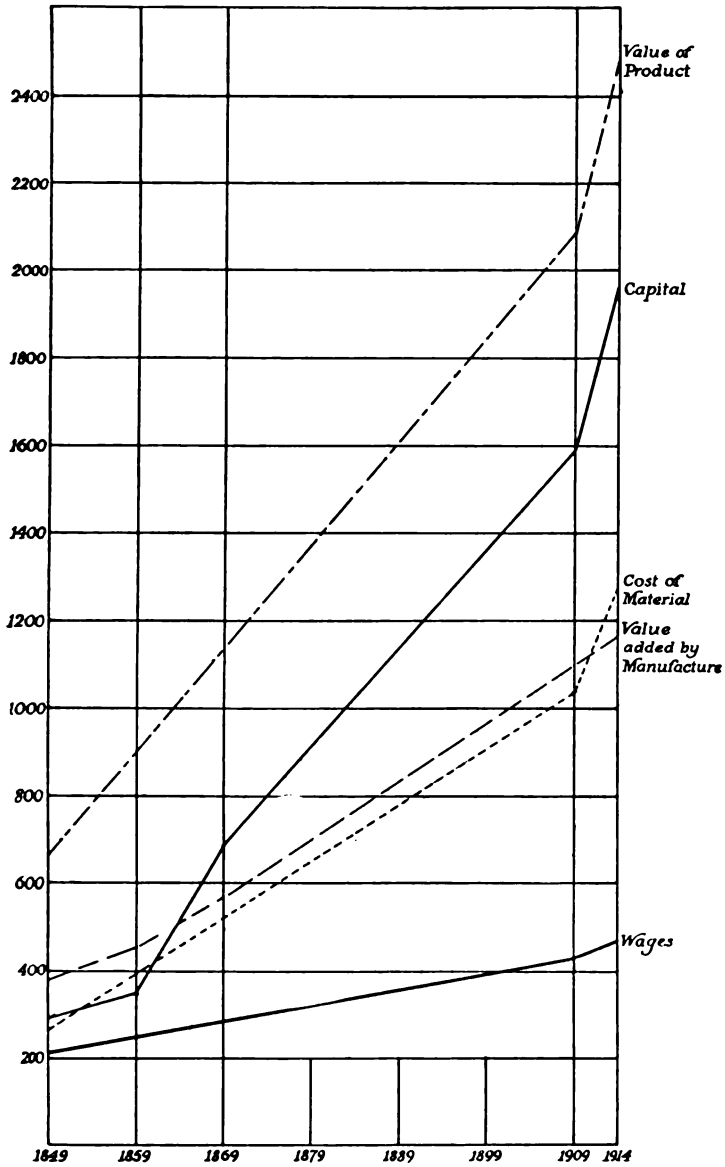
DEVELOPMENT OF THE BRUSH INDUSTRY
IN THE UNITED STATES

Showing Increase in Dollars per Wage Earner

	Capital	Wages	Cost of Material	Value of Product	Value Added by Mfg.
1849	296	221	265	654	389
1859	342	249	418	881	463
1869	694	284	541	1111	570
1909	1595	437	1033	2113	1080
1914	1987	479	1293	2480	1187

Average Number of Wage Earners per Establishment

1849	16
1859	19
1869	16
1909	18
1914	20



Development of the Brush Industry Showing Increase in Dollars per Wage Earner

Development of Machine Methods. Although a great many operations in the brush industry are still carried on by hand, machinery has come to play an important part in the making of certain kinds of brushes. The Table on page 8 shows the increase in dollars per wage earner for certain costs involved in the brush industry. In this Table it will be noted that the capital invested per individual wage earner was only \$296 in 1849, while in 1914 it was \$1987, or an increase of more than 600 per cent per individual. Some of this increase is undoubtedly due to the development of factory buildings, but obviously this does not account for the entire increase. A considerable portion of it must be attributed to the introduction of labor-saving machinery and equipment. Machine methods are now used in such operations as sorting bristles for length, mixing bristles, and stapling bristles.

Wages. Turning again to the chart on page 8 it will be noted that there has been a marked increase in the average wage paid to workers in the brush industry, although this increase seems relatively small as compared with other industries. It must be borne in mind, however, that the period between 1914 and 1917 has seen a further increase in wages which undoubtedly will be the minimum for the future, so that the wages paid in the brush industry at the present time compare more favorably than in 1914 with the wages paid in other industries. The brush manufacturer in the past has been laboring under two handicaps: first, the difficulties involved in a great number of hand operations, where production must of necessity be relatively uniform; and, second, he has had to compete with conditions in other countries where labor is much cheaper than in the United States.

The Work and the Worker. There are a number of features about the industry which should make it attractive to the worker. Although the increase in wages has been

**DEVELOPMENT OF THE BRUSH INDUSTRY IN THE
UNITED STATES**

United States	Number of Establishments	Wage Earners (Average Number)	Capital *	Wages *	Cost of Materials *	Value of Products *	Value Added by Manufacture *
1914	359	7,213	14,333	3,461	9,327	17,894	8,567
1909	384	6,954	11,092	3,041	7,187	14,694	7,507
1869	157	2,425	1,684	691	1,313	2,695	1,382
1859	121	2,378	914	594	994	2,097	1,103
1849	146	2,405	711	533	638	1,574	936

* Expressed in \$1000

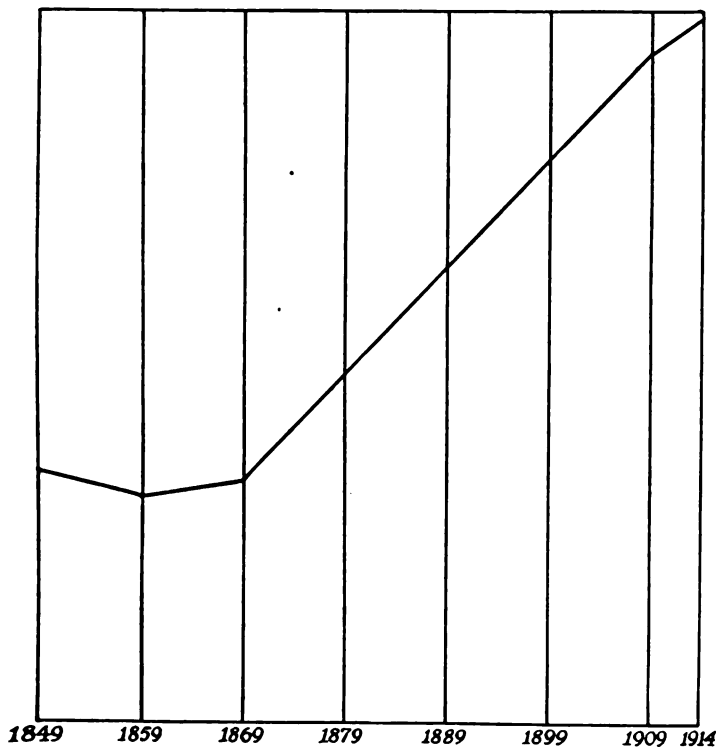


*Chart Showing Increase in Number of Persons Employed
in Brush Industry, 1849-1914*

relatively small up to 1914, there has been a consistent development. The Chart on page 11 shows that from 1849 to 1914 there has been a wholesome increase in the number of persons employed in the industry. A study of the Table on page 11 also indicates the promising growth of the industry from the standpoint of capital invested and products manufactured. The Table below shows the number of workers employed by months for the year 1914. It will be noticed how constant the employment was throughout the year.

NUMBER EMPLOYED BY MONTHS IN BRUSH INDUSTRY
IN UNITED STATES IN 1914

<i>Average for 1914</i>	7,213
January	7,446
February	7,441
March	7,440
April	7,339
May	7,222
June	7,102
July	7,114
August	7,043
September	7,082
October	7,298
November	7,066
December	6,963
Per cent Minimum is of Maximum	93.5

DISTRIBUTION OF WAGE EARNERS IN BRUSHMAKING
INDUSTRY IN CHIEF BRUSH-PRODUCING STATES, 1914

	Average Number Employed	Sixteen Yrs. of Age and Over		Under Sixteen Yrs. of Age	
		Male	Female	Male	Female
Massachusetts	1398	730	655	3	10
New York	1683	1188	476	8	11
Maryland	572	438	75	43	16
New Jersey	853	548	287	6	12
Ohio	664	518	146	..	..
Illinois	348	233	102	8	5
Pennsylvania	376	315	53	7	1

RELATION OF MALE TO FEMALE EMPLOYEES IN SEVEN
LEADING BRUSHMAKING STATES, 1914

Male	68 per cent
Female	32 per cent

Although many of the brushmaking plants are housed in older buildings, conditions of work are generally pleasant. A large number of women are employed and these are usually of a fairly high type. Very little of the work, even in machine operations, involves any serious risks to the worker. A worker who has once learned to handle bristles seems to have no difficulty in finding employment. In fact, a great number of these people have been retained in the employment of the same company for a long term of years.

The Brush Industry in the United States. A great variety of brushes is made in the United States at the present time. Among these are paint brushes of all sorts and various kinds of toilet brushes, tooth brushes, and cleaning brushes. In 1914 the total value of manufactured brushes was \$17,894,000. Only \$449,909 worth of these brushes were sent abroad that year, so that it will be seen that most of the brushes were produced for domestic use and that only in certain restricted lines were we able to compete with non-American brushmakers.

The effect of the war upon the brush industry has tended to give an impetus to manufacture in the United States. The European countries which have been constant competitors have either been unable to export to this country or have been unable to manufacture on the scale which they had reached prior to the war. In 1914 our imports from Europe were \$1,500,000; in 1917 they had fallen to \$400,000, making a difference of \$1,100,000, a portion of which, at least, fell to the local industries. In 1914 we exported to Europe brushes valued at \$449,909.

In 1917 we exported brushes to the value of \$863,630, an increase in exports of \$413,721. On the other hand, our imports from Japan increased 170 per cent during this period, so that while in 1914 we were importing brushes to the value of \$665,952, in 1917 our imports had reached \$1,500,300. This made an increase of imports from Japan of \$1,034,348, or an amount greater than the falling-off of imports from Europe. On the other hand, by taking into account the increase in our exports to Europe, we see that there was an important actual increase in the manufacture of American brushes.

Up to the present time, the American manufacturer has been able to compete in the toilet brush industry only in certain lines. A great number of these brushes have come from France, Japan, Germany, England, and Austria. The best qualities have come from France and England. The domestic manufacturers have been able to compete with foreign goods in the cheap and medium grades rather than in the more expensive toilet brushes. This is due to the fact that we are able to produce such brushes by machine processes, whereas in the more expensive brushes commonly made by hand, the United States is unable to compete with foreign labor.

Comparatively few manufacturers in this country have been able to compete with the imported tooth brushes. However, two or three firms at the present time are carrying on an excellent tooth brush business as the result of the introduction of machine methods. Although the American-made tooth brush cannot be produced to sell at as low a figure as imported brushes, it is of uniformly good quality, so that a reputation once established and connected with a trade name makes the domestic brush very acceptable to a large number of people who are attracted by its durability and a relatively moderate cost.

Brushes for applying paints, varnishes, etc., meet with very little foreign competition. Prior to the war, Germany was the only country that sent paint and varnish brushes to the United States. At the present time Japan is making efforts to sell paint and varnish brushes in this country, though little progress has been made. The popularity of the American-made paint and varnish brush in this country is due in part to the fact that it was able to establish a reputation for itself before the foreign manufacturers entered the market. There are also a number of other factors such as material, importation duties, etc., which have tended to make our brushes more popular.

The Future of the Brush Industry in the United States. It is to be hoped that the impetus which brushmaking has received in the past few years will not be lost. Although the small factory has a number of advantages, it has tended to retard the development of the machine methods. With the close of the war, labor conditions will tend to return to normal in Europe, but it is not likely that the scale of wages will be appreciably reduced. The tendency will, therefore, be for wages abroad to approach more nearly the wages paid in this country, so that to some degree we shall feel less keenly the competition of cheap labor in the brush industry. In order that domestic manufacturing shall continue to develop, the manufacturer should bear in mind three things:

1. Material saving in the cost of production can frequently be made by a study and careful re-arrangement of methods of handling material and by an analysis of operations which will tend to eliminate wasteful methods.
2. The introduction of a greater number of machine processes will tend to reduce the cost of production and at the same time will give an opportunity for an increase in wages.
3. There is a growing demand among Americans for a substantial product at a reasonable price. The manufacturer

can frequently educate his trade, through consistent advertising, to an appreciation of the ultimate value of his product, although the initial cost may be slightly greater than that of a less substantial substitute.

BRISTLES AND BRISTLE SUBSTITUTES

Bristles used in brushes come from hogs. Fine brushes, such as artists' brushes, are made from hair of fine texture, such as squirrel's. The so-called camel's hair brush is made from the hair of the Russian gray squirrel. There is some doubt as to the origin of the term camel's hair, but it seems probable that it was originally Campbell's hair.

The best hog bristles have come from Russia; in quality China has ranked second. France and Germany have also produced some bristles in the past. In this country we do not allow our hogs to get old enough to produce the strong texture which is necessary in a good bristle. The Russian bristle grows on hogs which are allowed to roam in a semi-wild state and which are exposed to the cold of winter. This develops a long bristle which is tough and will stand a great deal of wear. In the case of the Chinese bristles, which are of excellent quality, most of the hogs come from the inland regions where they must be much more hardy than our common barnyard variety of hog. At the present time some bristles are being imported from India. These are characterized by the length of the flag. The flag appears at the outer end of the bristle and is the breaking up of the individual bristle into a number of small ends. Prior to the war, German merchants controlled the bristle trade in Russia, and English and German merchants controlled the trade in China. Since the war, English capital has been playing a more important part in the Russian trade, though at the present time practically no bristles are being obtained from Russia.

The method of collecting bristles in Russia is interesting. A great many of the bristles come from rural districts which are a considerable distance from important towns. The farmers collect the bristles from their hogs as they are killed and store them in their homes until an itinerant peddler visits them. This peddler may make a business of buying only bristles or he may deal in other commodities. Usually he carries with him a stock of miscellaneous hardware and other household necessities which he exchanges for bristles. The bristles are taken to some trading center, such as Nizhni Novogorod. At this place fairs are held where the itinerant dealers sell their bristles to shippers or manufacturers. The bristles as they are brought in from the outlying districts are dirty. Some of them are thoroughly cleaned before shipping. Others are only roughly cleaned and are required to be put through a thorough cleaning process after reaching this country.

Besides bristles, a number of substitutes are used in making brushes of the cheaper grades. Horse hair is a common substitute; tampico and other fibers are used in the rougher sorts of brushes, such as floor brushes. Sometimes the substitutes are used alone, while at other times a layer of bristle is placed around the substitute.

Brushes. Brushes are generally classified as simple and compound. The simple brush, such as the ordinary paint brush, contains only one tuft of bristles. The compound brush, such as the tooth brush or hair brush, is made up of a number of tufts. Bristles are fastened into handles in the following ways:

1. Setting in cement or rubber. In this process the bristle is set in cement or rubber.
2. Wire drawn brushes. The bristles are fastened by a wire thread caught over the center of a knot of bristles, drawing it into a hole underneath. Commonly the wire is inserted from the back of the handle. In some cases, however, the

wire is drawn lengthwise through the middle of the handle so that it does not appear on the back at all and no covering is necessary. Brushes made in this way are said to be trepanned.

3. Pitch set. The bristles are dipped in pitch and inserted into the holes in the back of the brush.

4. Stapling. This process consists in fastening the knots in holes in the brush by driving a staple over them.

TREATMENT OF BRISTLES

Washing and Scrubbing. Most bristles, regardless of what cleaning they have gone through before reaching the manufacturer, are washed in the brush plant. The bristles are first allowed to soak in large vats. In some cases the cleansing is made more thorough by boiling the bristles. In this process the bristles are immersed in water and steam is turned into the water. White bristles are put through a scrubbing process. The bristles are immersed in soapy water and are scrubbed either by hand or by machine. In this process the worker rubs the bristles over a stone, thereby loosening any particles of dirt which have not previously been washed out. In the machine process, a combing device is drawn through the bristles, thereby rubbing them and mixing them thoroughly with soap. After being thoroughly scrubbed the bristles are rinsed. In many plants they are dried by being placed in drying rooms where a constant temperature is maintained for a number of hours.

Putting Bristles in Cones. Before bristles are boiled they are either put in a small metal flask called a cone, which tapers slightly towards the bottom, or else they are wrapped firmly with string. In putting the bristles into the cones the flag or smaller end is downward. This method of confining the bristles is employed to assist in straightening them.

When the bristles are removed from the drying chambers they are thoroughly dry and straight, and can be removed from the cones or bundles. In most instances, the work of putting the bristles into the cones, and of boiling, washing, and scrubbing is done in part, at least, by the same men. The tying of the bristles requires considerable experience, as is true of all operations where bristles are handled. Anyone not familiar with the brush industry is surprised at the difficulty involved in handling slippery, tapering bristles which tend constantly to slip about in one's hands. Experienced handlers of bristles have generally spent from three to five years in the industry. The work of tying bristles and putting them into cones is light except in factories where the worker is expected to handle boxes of bristles which weigh from 130 to 160 pounds. If provision could be made to bring the bristles to the worker he could remain seated most of the time, and consequently the loss of a leg would not be a serious handicap. Hernia or defective hearing would also not prevent him from doing this work. On the other hand, the worker must develop a delicate touch and skill in handling bristles, and any form of nervous disorder would be a serious drawback. As has been suggested, unless special training in handling bristles could be given the worker it would take him a number of years to gain proficiency. The wages vary from \$18 to \$20 a week. The other operations, previously described, would require an able-bodied worker. The wages are about the same.

In some cases the bristles are bleached after they are washed. This work is very similar to the washing process, as far as physical requirements are concerned.

Hand Combing. After the bristles are removed from the drying chambers they are usually combed out to break up the bundles and to eliminate any bristles which are not straight in the bundle. The work of combing is

commonly combined with some other operation such as mixing. The worker would be compelled to stand and ought to have the use of both hands, although it is possible that the loss of one or two fingers would not prevent him from engaging in this operation. Hernia or defective hearing would also not prove serious handicaps. The same training is required in this operation as is required for other operations where bristles must be handled. When this work is combined with another operation the salary usually varies from \$20 to \$30 a week.

Sorting Bristles for Texture. In the making of brushes, such as toilet brushes, where the bristles must be of a uniform thickness, it is necessary to sort them. This is commonly done by putting the bristles in a boxlike tray about eighteen inches long and half as wide. The tray is divided into a number of square compartments, each one of which holds bristles which are put in with their thin or flag end down. The bottom of the tray, instead of being solid, is made of a small mesh wire. After the bristles have been put into the case, the operator shakes and pounds it on the table. This forces the bristles of small diameter part way through the mesh. After the operation of shaking is completed the worker draws out all the bristles which have come through the mesh. These will naturally be of fine texture. This work requires considerable activity on the part of the worker so that with the exception of the loss of two or three fingers, hernia, or defective hearing, he should be able-bodied. Inasmuch as he must handle the bristles, his training should be the same as that previously mentioned. Wages range from \$15 to \$20 a week.

Dragging Bristles. Dragging is the process by which bristles are sorted according to their lengths. The work is done either by hand or by machine. In the case of hand dragging the operator takes a bunch of bristles in one

hand with the butt or thicker ends arranged evenly. This allows the flag or thinner ends to protrude according to their varying lengths. The operator then takes a small knife and by drawing it through the bristles at varying heights selects them according to their lengths. The bristles are arranged in piles varying by a quarter of an inch. In the case of machine dragging the bristles are laid out on a narrow shelf three or four feet long, with their butt ends arranged flush against the back of the shelf. This, as in the case of hand dragging, allows the various lengths to protrude. When the machine is set in motion a clamp arrangement opens and closes on the bristles, picking out first the longest ones. The same mechanism passes the bristles to the rear of the machine and drops them into pans. At each operation the clamp device moves a quarter of an inch nearer the bristles so that they are picked out in lengths varying by a quarter of an inch. In both hand and machine dragging the operator must have had experience in handling bristles. He should be able-bodied, with the exception of possible loss of two or three fingers, hernia, or defective hearing. In the case of hand dragging, the loss of one or both legs would not be a serious handicap, providing arrangements could be made for carrying work to and from the operator. Wages are about \$20 a week.

Cutting Bristles. In the making of toilet and similar brushes it is desirable to have the bristles of uniform length. This involves the trimming of the bristle ends. This work is usually done in a bench shears between two blades built so as to form a V-shaped opening into which the bristles are placed. The shears are operated by hand. This work is usually combined with some other operation, such as sorting for texture. The cutting operation itself requires a man with moderate physical strength in his arms. In most factories it would be necessary for him to

move around the shop more or less. The loss of one or two fingers would not prove a serious handicap, although the worker would have to be able to handle bristles with facility. Heart trouble, hernia, or defective hearing would not prevent one from doing this work. This operation is usually combined with other work so that the man receives a salary of from \$20 to \$30 a week. His training would be similar to that required in other bristle-handling operations.

Mixing Bristles. Various methods are used for mixing bristles where it is desired to unite different qualities or textures in the same brush. Bristles for tooth and hand brushes are commonly mixed by scattering them in layers over a table. These bristles are thoroughly stirred and mixed by hand. This work naturally requires the constant use of the hands, and the worker must be able to stand and move about, so that with the exception of loss of fingers, hernia, heart trouble, certain nervous disorders, or defective hearing he should be able-bodied. The work of mixing or 'shaking up' does not require a great amount of experience, and it is common to put beginners in the bristle department at this work. Two or three days' experience would be sufficient to fit one for this work. The wages are about \$20 a week. In mixing bristles, particularly for paint brushes, a mechanical method is frequently used. After the bristles have gone through the hand-combing process they are placed in the mixing machine. By passing over a series of endless belts they are thoroughly mixed. While this operation of mixing is being carried on the bristles are combed. This is done by carrying them on a belt to which they are firmly held by means of a chain following the belt. The belt passes them through a revolving comb device which draws out the bristles which have become crossed or bent. This machine throws out a considerable amount of bristles which must

be reclaimed. The machine method of mixing and combing is, therefore, more wasteful of material than the hand method, but on the other hand it does considerably more work in the same time. Each mixing machine is in charge of an operator who must be active both with his hands and with his legs. The loss of one or two fingers would probably not interfere with this work. In other respects the worker should be able-bodied. His training is the same as that for other workers in bristles. The wages vary from \$25 to \$30 a week on a piece basis.

Bunching Bristles. After the bristles have gone through the processes previously described they are usually tied in knots. This is particularly necessary when the bristles are used in some mechanical process of brush-making. The work of bunching is done at tables by workers who are seated. In most cases women do the bunching. The physical disabilities are the same as for other sitting operations where the use of the hands is particularly important. A fair amount of experience in handling bristles is a prerequisite in this work. The wages of women workers are \$12 or \$13 a week.

Trimming Bristles in Bunches. Where it is desirable to have the bristles of exactly the same length the ends are clipped off after they have been bunched. This work is done with a clipper similar to that used in barber shops. The clipper is stationary and operated by power. Usually the trimming of the bristles does not offer enough work to keep one person busy all the time. The physical disabilities would be the same as for other operations where the worker is required to move about for a portion of the time. The wage would probably be determined by the other operation in which the worker was engaged.

Reclaiming Bristles. Where a considerable amount of bristles is thrown out in the process of handling, some method of reclaiming these bristles is generally used.

Reclaiming consists of two primary operations: first, the combing and straightening of the bristles, and second, the arrangement of the bristles with the flag ends together. The work of combing is very similar to the work of the hand-combing operation previously described. Two methods of arranging the flag and butt ends of the bristles will be suggested. In the first method the bristles are drawn over a fine mesh comb. This comb catches the butt of the bristles only. Since the flag end is smaller and does not stick in the mesh it is then a simple matter to pick the bristles out with their butt and flag ends together. This operation is repeated until all the bristles have been sorted. The second method depends for its operation on the fact that bristles taper from their butt ends to their flag ends. By arranging them in a long row across a table and working the hand or a board across them at right angles, the bristles with their butt ends outward will work away from the hand or board. These are picked up from time to time during the process until all the butts have been placed together. The work of reclaiming requires standing and moving about, so that the operator should be able-bodied with the possible exception of the loss of one or two fingers or defective hearing. As in the case of other operations where bristles are handled the worker requires considerable experience. Wages vary from \$25 to \$30 a week.

WIRE DRAWN BRUSHES

Drilling Holes in Backs. The process of making trepanned brushes will not be described in detail as it is not common in this country. It is, however, a phase of the wire-drawn method for making brushes. The backs of wire-drawn brushes must be drilled in such a way that a shoulder will be formed in the hole against which the knot

of bristles will be drawn securely by the wire which comes through from the opposite side. The work of drilling is done with a small power drill, operating in a horizontal rather than a vertical plane. The worker has a tool rest on which he holds the back of the brush. His drill is so arranged that it bores a hole which is large enough to receive the knot of bristles on one side, but only large enough for the insertion of the wire on the other. The work of drilling must be done rapidly, as in many brushes there are a great number of knots of bristles. Facility in this work can be obtained only through experience. The operator should be able-bodied with the exception of the loss of one or two fingers on one hand or the loss of a leg below the knee, defective hearing, or hernia. The wages are about \$25 a week.

Drawing Bristles. The work of drawing bristles is usually done by women. It is an uneconomical operation, as it involves a maximum of labor with a minimum of production. The worker is seated throughout the day at a small table. The bristles are placed conveniently on the table and the worker selects from the pile the required amount to make each knot. The knot is placed through the loop in the wire which has been drawn through the hole in the back, and then the wire is drawn firmly into the hole. This fastens the bristles securely and the wire is threaded through the next hole. Loss of legs would not be a serious handicap in this work. The worker, however, should have the use of all of his fingers. Hernia, heart trouble, defective hearing, or stiffness of trunk muscles would not prove serious handicaps. It is possible with special training and with special arrangements of the working table that an operator partially or totally blind could learn this work, though it is probable that he would have to confine himself to the making of certain types of

brushes, as the pattern to be followed in lacing through the holes varies in different types of brushes.

Window and some styles of toilet brushes are commonly made by the hand-drawn method. The wire at the back of the brush is covered by a thin strip screwed or fastened in some similar method over the holes. The worker must have experience in handling bristles and his fingers must be trained to select a uniform quantity of bristles for each knot, as too few would make a thin knot and too many would make it impossible to draw the knot into the hole and would add to the cost of the brush. The wages for women workers are \$12 to \$15 a week.

HAND-SET BRUSHES

Drilling Holes. The backs of the hand-set brushes are drilled in a manner similar to that employed in drilling backs of wire-drawn brushes except that the hole is not carried entirely through the back.

Tying, Dipping, and Setting. These three operations are done by a single worker. The equipment is practically the same as that for wire-drawn work except that no wire is used. The worker selects a knot of bristles, dips one end in pitch, ties a thread around one end, again dips the end in pitch, and inserts it without doubling into the hole which has been drilled in the back or handle. This operation is repeated until the holes are all filled. The physical requirements and experience are the same as in the case of wire-drawn brushes, though it would probably be more difficult for the worker to get along without relatively good eyesight. The wages are the same as in the case of wire-drawn work.

Brushes which are set in pitch are usually of the cheaper variety and are not expected to be used in hot water or in chemicals which would affect the pitch.

STAPLED BRUSHES

Drilling. Staple brushes are drilled in a manner very similar to the set brushes. Care must be taken to leave sufficient wood to receive the staple.

Stapling. Stapling is usually done by machinery. The staples enter the machine in the form of wire. By a mechanical arrangement the staple is bent over the center of a knot of bristles and they are forced into the hole in the back or handle of the brush. A particular phase of this work will be described in a latter portion of this report in connection with the making of tooth brushes. The operator of the stapling machine should be able-bodied with the exception of loss of two or three fingers, hernia, or defective hearing. The wages are about \$20 a week. The stapling process is growing in popularity because it can be done mechanically. A variety of brushes are at present stapled. Among these are handbrushes, scrub-brushes, and tooth brushes.

TYPES OF SIMPLE BRUSHES

General Discussion. As has been suggested in the early part of this report, brushes are divided into simple and compound brushes. Those which have already been described have been of the compound variety. There are a great number of brushes containing a single tuft of bristles. In practically all of these brushes the bristles are held together or are held to the handle by some form of cement. In the case of the more durable brushes the bristles are set in rubber. These brushes can be divided roughly into the following classes: (1) stucco brushes, (2) flat wall brushes, (3) round and oval brushes, (4) kalcimine and whitewash brushes, (5) flat varnish brushes, (6) sash and artists' brushes, (7) lather brushes. These brushes vary in shape, quality of material, and method of manufacture.

STUCCO BRUSHES

Knot-Making. In a great many stucco brushes pure bristles are not used. The center is sometimes formed of a mixture of horsehair and bristles. The work of making the brush is done at a small table, usually by women. They select the proper amount of horse hair and bristle. By laying out the bristles over the horsehair and cleverly folding the knot, the bristles are made to completely surround the horse hair. Care must also be used so that the bend of the bristle is towards the center of the brush. The flag ends of the bristles are always placed outward in all brushes. After the knot has been formed, a plug is inserted in the center of the butt end of the knot and a false ferrule is fitted over the bristles. This work can be done seated so that loss of legs would not prove a serious handicap. Heart trouble, hernia, or defective hearing would also not prevent one from doing this work. On the other hand, the worker should have complete control of his hands and fingers, for skill of manipulation is required, as in the case of other bristle-handling operations. Without special training the worker requires a number of years' experience before becoming familiar with this form of brushmaking. The wages are from \$16 to \$18 a week.

Cementing Bristles. With the exception of rubber cement, bristles are cemented in the same general way. The object in cementing is to see that the cement thoroughly permeates the knot. In some cases the ends of the knots are allowed to stand in cement for a considerable length of time. In the case of smaller brushes the ferrule is placed on the brush before the cement is applied. In this form of cementing the cement is forced into the bristles by means of compressed air. Stucco brushes are usually treated in the former manner. The larger brushes are usually cemented by men. The worker should be able-bodied with the ex-

ception of loss of two or three fingers or defective hearing. Two or three months' experience is necessary. Wages range from \$14 to \$18 a week for men. In the case of the smaller brushes girls do the cementing. A good deal of this work could be done seated, so that the loss of a leg below the knee would not be a serious handicap. The other handicaps are the same as in the case of the men operators. Girls receive from \$12 to \$14 a week.

FLAT WALL AND VARNISH BRUSHES

Gumming Bristles. After the brush has been formed it is frequently desirable to treat it so that the bristles will not be disturbed until it has passed through the different processes of making. In order to hold the bristles in their original form they are dipped in a solution of flaxseed, which, when it is dry, holds the bristles together. The gumming is done chiefly in the case of brushes which are to be vulcanized in rubber. The work of gumming is done by girls who are seated. The operation consists of dipping the brush in a pan of flaxseed solution. Although the operation appears simple at first sight, the worker must be careful that the bristles are correctly shaped in the brush, for otherwise the form of the brush would be spoiled. The loss of one or both legs, two or three fingers, hernia, heart trouble, or defective hearing would not prove serious handicaps. It seems possible also that with training a worker with partial or total loss of sight could learn to do this work. The wages are about \$12 a week.

Making Flat Wall Brushes. Flat wall brushes are made in the same general manner as stucco brushes, except that a metal ferrule instead of a leather binding is generally used. Instead of inserting a plug the brush is sometimes made solid. The operations involved in making the brush are so similar to those involved in making stucco brushes that no further description will be offered.

Making Flat Varnish Brushes. Both the flat wall and flat varnish brushes are set in either cement or rubber. Flat varnish brushes are commonly smaller than the wall brushes. They are usually fitted with a tin ferrule which is nailed to the handle. The work in making the flat varnish brushes is very similar to that described for other brushmaking processes.

ROUND AND OVAL PAINT AND VARNISH BRUSHES

The bristles for round and oval paint and varnish brushes are made into knots in a manner similar to other knot-making operations, and require the same experience.

Fitting Ferrules to Oval and Round Brushes. A number of methods are used for putting the ferrules over the knots. In some cases the bristles are treated with a small amount of cement. The ferrule is placed over the butt end of the knot, and the pointed handle commonly used in this variety of brush is driven through from the opposite end. This furnishes the brush with a plug, and at the same time forces the bristles firmly against the ferrule. The ferrule used in making these brushes is shaped like an inverted cup with a hole left in the bottom to permit the handle to pass through. The worker must be able-bodied, with the possible exception of loss of fingers or defective hearing. The driving of the handle into place is done with a small sledge, so that a fair amount of strength is required. On a piece basis the wages range from \$20 to \$25 a week. Three or four months' experience is necessary before the worker has acquired a sufficient degree of efficiency.

Making Brushes with Chiseled Ends. An examination of the better grades of varnish brushes will show that the ends taper slightly. This taper is put in to insure a regular and even flow of paint. It is also highly desirable that the

flag ends shall not be clipped in order to obtain this taper, as the flag of the bristle assists in holding and distributing the paint. As a matter of fact, in some cheaper grades of brushes the end of the brush is made even and the taper is put in by clipping the bristles. In the round and oval brushes it is particularly important that the taper be made, as the brushes are unusually thick. Two of the most characteristic methods for obtaining this taper will be described. In the first method, a knot of bristles is placed in a metal cup the size and shape of the brush. The bottom of this cup is slightly concave, so that the bristles take on the shape of the bevel. The bristles are tied in this form prior to cementing and placing in ferrules. Most of the ferrules for oval and round brushes are made of iron rather than tin. In another method for obtaining the bevel the bristles are tied in knots with their butt ends even; the worker depresses the center of the butt end of the knot, thus forcing the center of the brush outward and making the bevel at the flag end. In both methods for beveling brushes the worker may remain seated for the entire work, so that loss of one or both legs would not prove a serious handicap providing the work was brought to the bench. Loss of one or two fingers, hernia, heart trouble, or defective hearing would also not prevent him from engaging in this work. The worker should have the experience or training suggested in other operations where bristles are to be handled. The wages vary from \$20 to \$25 a week.

Putting Handles on Oval and Round Brushes. One method of fastening handles to round and oval brushes has already been described. The other most common method is one which slightly decreases the outside dimensions of the ferrule with pressure at its two ends, thus clamping it over the knot and the handle at the same time. In some cases this is done with a screw

press operated by hand. In other cases the pressure is obtained in a machine press fitted with dies of the desired dimensions. Where the press is used the worker must be able-bodied in all respects, with the possible exception of the loss of one or two fingers or defective hearing. One or two months' experience would be necessary. Wages range from \$20 to \$25 a week.

The operator of the machine press may do most of his work seated providing the material is taken to and from his machine. Loss of two or three fingers or defective hearing would not prove a serious handicap, and it is probable that the loss of one leg below the knee would not prevent one from acquiring a moderate degree of efficiency in the operating of the machine press. The wages are about the same as in the case of the hand press.

SASH, ARTISTS', AND LATHER BRUSHES

Making Small Brushes. In the case of sash and artists' brushes, hair is frequently used instead of bristles. The work is similar to the making of other brushes, and it involves the same handicaps and training and wages. As in the case of making the other brushes, women are chiefly employed. The handles are fastened to the knot with small ferrules. This work is also bench work, and may or may not be combined with the operation of making knots.

Making Lather Brushes. Lather brushes are made of hair and bristles. The more expensive ones are made of badger hair. A great many lather brushes are at the present time being set in rubber in order to give them greater durability. The making of the knots for the brushes is similar to other knot-making processes.

Setting Bristles in Rubber. The process of setting bristles in rubber will be described for lather brushes. A similar method is employed in the case of other round and flat brushes. After the bristles have been tied in knots,

they are allowed to stand in a perforated tray with the butt ends downward. Rubber cement is then allowed to flow through the perforations of the tray until three-eighths or half an inch of the bristles is immersed. The bristles remain in this cement for various lengths of time, according to the size of the brush and the type of bristle or hair used. After the cement has thoroughly permeated the knot, the bristles are removed to a warm room where they remain over night, allowing the solvent in the rubber cement to evaporate. The ferrules are then fitted to the knot after the cement has been slightly softened on a warm plate.

In some cases, instead of dipping the bristles, ferrules are placed over the knots, and the right amount of rubber cement is poured into the ferrule. The brushes are arranged in racks with the flag ends of the bristles downward, so that the cement gradually soaks into the knot. In both the dipping and pouring processes a final vulcanizing takes place before the brush is ready to leave this department. In the dipping method the worker should be able-bodied with the exception of the loss of two or three fingers. The work involves the handling of sheets of rubber stock. These sheets are cut into strips and placed in large cylindrical mixers along with the necessary solvents. The worker must also handle the trays of brushes, so that there is a considerable amount of heavy lifting and moving about. Where the rubber cement is poured, women do the work. In most cases the work involves a considerable amount of moving about and stooping, so that loss of legs would be a serious handicap. Loss of two or three fingers or the loss of a hand or arm, hernia, or defective hearing would not prove serious handicaps, providing the worker could be relieved of all lifting, and providing he could acquire a fair amount of dexterity with his good arm. The dipping process requires

two or three months' experience, though the work of pouring the cement could be learned in a very short time. Men in the dipping room receive from \$18 to \$25. The wages for the women who do the pouring are from \$12 to \$15 a week. These women also put the ferrules on the brushes in most cases.

MAKING FERRULES AND FINISHING HANDLES

Cutting Tin. Up to this point the discussion has dealt with the general process of making brushes. There are a number of operations, however, which are usually carried on in brush factories through which the brush must pass before it is completed. In most of the smaller types of brushes tin ferrules are used. The tin for the ferrules is received at the factory in sheets or rolls. It is first cut into proper dimensions on a shear press. This work is usually done seated, though in some cases the operator is expected to supply himself with material. Besides cutting the tin for ferrules a design is often stamped in the ferrule blank. Providing material could be taken to and from the worker, loss of one leg below the knee, loss of two or three fingers, or defective hearing would not prove serious handicaps. The work could be learned in a comparatively short time. It is done by either men or women. The wages vary from \$12 to \$18 a week.

Bending Ferrules. After the tin has been cut to the desired size, it is bent in a press machine into the ferrule. The work is comparatively light and is done on a piece basis. The operator could remain seated for the entire day provided his material was brought to and from the machine. The loss of one leg below the knee would not prove a serious handicap where the machine is controlled by a foot-treadle. Loss of two or three fingers, hernia, or defective hearing would also not prove serious handicaps.

The work does not involve a lengthy period of training. Wages are about \$12 a week.

Soldering Ferrules. After the ferrule has been bent into shape, the ends are soldered. The worker may be seated or may stand, as he sees fit, so that the loss of a leg would not prove a serious handicap. However, in most cases he is expected to handle the case of ferrules. If other arrangements could be made for this work he would not have to move about the room at all. As each ferrule must be handled individually, rapid use of the hands is necessary. Beside the disability suggested, the worker would not be seriously handicapped by the loss of two or three fingers or defective hearing. Slight fumes are given off in the soldering process, although they do not seem to be sufficient to make the work unhealthful. Several months' experience would be required to learn the work and reach a maximum of speed. Wages are about \$25 a week on a piece basis.

Stamping Holes. In the case of some ferrules, where nails are driven through the cement of the brush, it is necessary to stamp the holes. This work is comparatively light, and is done on a press machine, usually by women. Loss of a leg below the knee, loss of one or two fingers, hernia, or defective hearing would not prove serious handicaps. A month's experience would be sufficient to gain moderate familiarity with the work. Wages are from \$12 to \$15 a week.

Tumbling. After the ferrules have been shaped and soldered they are put through the tumbling machine. This consists of a long revolving cylinder into which are placed the ferrules together with sawdust. The contact of the ferrules with the sawdust removes all acid or grease remaining on the tin. The operation of this machine requires no skill. The worker, however, must be active, with the exception of the loss of two or three fingers or

defective hearing he should be able-bodied. Two or three weeks' experience would offer sufficient training. The wages are from \$15 to \$20 a week.

Nailing Ferrules to Handles. In most instances paint brush handles are made outside of the brush factory, and in some cases they are painted outside the factory. Most brushes with tin ferrules have the ferrule nailed to the handle. In cases where a plug is used the nail goes through that portion of the handle. The work of nailing is done on an automatic machine which collects the nails from a drum, so that they hang point downward from a small chain conveyor. In this way they are carried to a position directly under a small vertical rod. When this rod descends it drives the nail through the ferrule into the handle of the brush. The operator places the brush in a clamp under the driving device, and the machine drives and spaces the nails automatically. This work is usually done by women who may remain seated throughout the day. Providing material is brought to the machine and taken away by some one else, the operator would not be seriously handicapped with the loss of one or both legs. Loss of two or three fingers, hernia, or defective hearing would not prevent one from working at one of these machines. It is also possible that with the assistance of a special appliance this work could be done with the loss of hand or forearm. Wages are from \$12 to \$15 a week on a piece basis. In a few cases nails are driven by hand, although this is not common.

Trimming Ends of Nails. Where the nails are driven through the opposite side of the ferrule the ends must be cut and turned. This work is usually done on a machine operated by hand, which first trims off the end of the nail and then turns it over. The work is done by forcing a bar, operated by a hand lever, across the nails, thus turning them down after they have been trimmed off. No

skill is required in this operation though considerable speed is necessary in order to make the day's wages. The work is usually done by boys or women. Loss of fingers, hernia, or defective hearing would not prove serious handicaps. Providing arrangements could be made for placing and removing work this operation could be carried on by a partially or totally blind person if he had had proper training. Wages are about \$12 a week.

Fitting Handles to Small Brushes. In the case of small, cheap brushes, handles are not carefully fitted into the ferrules. When the handle does not fit the ferrule exactly, the worker grinds it on an emery wheel. This tends to make a loose-fitting handle, as there is no force used in attaching it. This work requires rapid use of the hands, though the worker can remain seated throughout the day providing his work is brought to him. Loss of one or both legs, loss of two or three fingers, hernia, or defective hearing would not prove serious handicaps. The work is not skilled, so that it could be learned in three or four weeks. The wages vary from \$15 to \$20 on a piece basis, both men and women being employed.

Cleaning Brushes. Paint and varnish brushes are usually cleaned before they are sent from the factory. The cleaning is commonly done by a device which stirs the bristles, and at the same time draws off the dust by a suction arrangement. In a common form of cleaning machine the operator sets the brushes around the edge of a revolving wheel, the bristle ends out. This wheel is partially enclosed in the hood of the suction pipe. While the wheel is being revolved the operator runs a hand brush through the bristles. He must be active with both feet and hands, and with the exception of loss of two or three fingers should be able-bodied. His work does not take any degree of skill and can be learned in two or three weeks. Wages are about \$19 a week.

Buffing Ferrules. Before the brushes are wrapped the ferrules are run over a buffing-wheel which polishes the tin, giving it a pleasing surface. This work could be done seated provided material is brought to the operator, so that loss of one or both legs would not prove to be a serious handicap. Loss of two or three fingers, hernia, or defective hearing would also not prevent one from doing this work. Wages are about \$15 a week.

Stamping Brush Handles. Most paint brushes and varnish brushes are stamped with the trade name upon the handle before being wrapped for shipment. The brushes are commonly laid out in a row on the table. After the table has been filled, girls pass along with a metal die which stamps the impression by being struck a firm blow with a hammer. The use of both hands and legs is necessary in this work. Loss of two or three fingers, hernia, heart trouble, or certain nervous disorders, or defective hearing would not prove serious handicaps. At least one of the girls engaged in the work must be thoroughly familiar with the dies, where a variety of trade names are used. Other girls, however, could learn the work in two or three weeks. Wages vary from \$14 to \$16 a week.

Dipping Brush Handles. Where brush handles are painted in the factory, the work is usually done by dipping. This operation will be described in more detail under a later heading. In the case of paint and varnish brushes much of the dipping is done by hand, so that each brush is handled individually. Most of the work is done by women. The loss of fingers or defective hearing would not prove to be a serious handicap. Wages are \$12 or \$13 a week.

Wrapping Brushes. Paint and varnish brushes are usually put in individual wrappers before they are shipped. This work is done by girls and involves no skill

except that which could be acquired by one or two months' experience. By making a slight readjustment of methods in common use the work could be done seated. Loss of one or two fingers, hernia, heart trouble, or defective hearing would not prevent one from doing this work. With special training a totally blind person could reach a fair degree of efficiency. The wages vary from \$12 to \$15 a week.

MANUFACTURE OF TOILET BRUSHES

In the case of special operations involved in the making of toilet brushes it is desirable to discuss certain processes under a separate heading. The process of treating bristles in general is the same as that already described. Unlike the paint and varnish brushes, the handles for toilet brushes are commonly made in the brush factory.

Cutting Stock for Backs of Toilet Brushes. Various sorts of wood, such as maple, oak, walnut, and ebony are used in making these backs. The wood usually reaches the factory as lumber and must be cut into the desired lengths and widths. The cutting is done by circular saws, similar to those to be found in any mill. The work involves a fair degree of skill and care in manipulation in order to obtain speed of production combined with safety. It is possible that where partially cut stock is handled the worker could have an artificial leg below the knee. With the exception of this handicap or hernia he should, however, be thoroughly able-bodied. Two or three months' experience at least is necessary. Wages are about \$15 a week.

Planing Stock. After the stock is cut to size in two dimensions, it is run through a planer to obtain the desired thickness. The planer consists of revolving knife-blades into which the stock is fed by the operator. Both surfaces are trimmed at one time. Providing there is enough work to occupy the entire time of one man and providing he

would not have to carry his material to and from the planer, a worker with an artificial leg below the knee could operate this machine. The loss of one or two fingers, hernia, or defective hearing would also not be serious handicaps. The wages are about \$15 a week.

Shaping Brush Backs. Brush backs are not rectangular but have to have their corners rounded, and, in some cases, their top is concave or convex. After the backs have passed through the saws and planer, they are taken to the shaper. In this machine a series of small knives is arranged on a vertical spindle which passes through the worker's table to a height of two or three inches. This spindle revolves at a considerable speed. The block, which is to be shaped, is fastened to a pattern by means of short pins protruding from the pattern. The worker holds the block against the revolving blades until the block is the same shape as the pattern. One worker may have more than one shaping tool, according to the number of operations he is expected to perform. Each shaping tool adds some element of design to the finished back. In this work the operator usually is expected to stand, though with the exception of keeping himself supplied with stock, he does not have much moving around to do. An artificial leg below the knee would not be a serious handicap. Loss of one or two fingers, hernia, or defective hearing would also not prevent him from doing this work. On the other hand, he must be able to acquire a marked speed in the use of his hands in moving the blocks dexterously around the cutting edges of the spindle. He should, above all things, have a well-balanced nervous system, as a mismove on his part might lead to the loss of fingers. Work is usually done on a piece basis, and pays from \$20 to \$25 a week.

Sanding. After the brush backs have been cut into shape they are sanded by being held against revolving rolls covered with sandpaper. In this way the operator

can reach the concave surfaces without difficulty and can finish the operation of shaping. The work is usually done seated so that the loss of one or both legs below the knee would not be a serious handicap. The worker must, however, have full use of his hands, as rapidity of motion is essential. The loss of one or two fingers, hernia, or defective hearing would not prove serious handicaps. One or two months' experience, at least, is necessary, and it seems probable that a man should have a natural aptitude for this sort of work. The wages vary from \$12 to \$20 a week.

Cutting Cavities in Brushes. Where the bristles are set in some form of block which is fastened to the back of the brush, it is necessary to cut a depression in the back so that the block will fit into it. The back is fitted into a form which has an opening the same shape and size as that desired for the cavity. The cutting tool is similar to that used in shaping. The cutting tools are usually used in series, each tool performing a certain part of the operation. If arrangements could be made for the operator to have his work brought to him, the loss of a leg below the knee would not be a serious handicap. With the exception of the loss of one or two fingers or defective hearing, no other disability would be possible in this work. The operator in the case of shaping must work rapidly and accurately, and he must be able to set up his own machine. Three or four months' experience would be necessary to gain full familiarity with the work. Wages are from \$12 to \$18 a week.

Painting Brush Backs and Handles. Two methods of painting brush backs and handles are common. The dipping method, which has been mentioned, is the more popular at the present time. In this method large vats of paint are provided and the brushes are dipped either one at a time or in groups arranged on racks. Where the

brushes are hung on racks, a small hook is usually driven into the back. Driving the hooks could be done seated so that the loss of one or both legs, heart trouble, hernia, certain nervous disorders, or defective hearing would not prove serious handicaps. The wages are about \$12 a week.

Hand dipping, as has been stated, is usually done by women. When the brushes are dipped in quantities they are hung on a rack which is lowered into the paint by some automatic arrangement. This work is usually done by men. The operator should be active so that loss of two or three fingers, hernia, or defective hearing are the only handicaps which would not interfere with this work. The constant odors of paint or lacquer would prevent any one from doing this work who is ordinarily affected by them. One or two months' experience would offer sufficient training. Wages are about \$20 a week.

Spraying. Spraying is becoming a more popular method for applying paint. The paint or lacquer is contained in a can holding between a pint and a quart of the liquid. By introducing compressed air into the can a fine spray is blown over the handle. This work is usually done seated, the operator holding the brush back in one hand and the spraying device in the other. Frequently some method of carrying off fumes is employed, but even under these conditions there is a marked odor in the room where the work is done. The work involves the same general physical requirements as are needed for dipping, and the wages and training are about the same.

Sanding and Polishing. The finer finishes on toilet brushes are obtained by rubbing the paint or lacquer after it has dried. This work usually involves two or three operations which vary only in that the surface is rubbed with different finishing materials. The first operation is usually rubbing with a very fine sand paper. This is followed by rubbing with a polishing dust, such as pumice.

In a third operation a polishing oil may be applied. All these processes permit the same physical disabilities. The worker may remain seated throughout the day, so that loss of legs would not prove a serious handicap. The loss of one or two fingers, heart trouble, hernia, or defective hearing would also not seriously interfere with the work. Hands and arms must be in constant use, and a moderate amount of muscular strain must be maintained constantly. One or two months' experience, at least, is necessary, and in the case of finer finishing, a longer period is desirable. Wages vary from \$17 to \$20 a week.

Cutting Aluminum Plate for Bristles. The common method for making toilet brushes in this country is to set the bristles in cement. The bristles are usually set in a convex metal plate into the back of which the cement is poured. Aluminum is a very desirable form of metal to be used, as it will not rust or corrode. The aluminum is stamped out in a press machine and at the same time drilled with holes for receiving the bristles. This work can be done seated, provided material is carried to and from the machine. The operator requires the use of both hands, though the loss of two or three fingers would not prove a serious handicap. He should be particularly free from any nervous disorders, as there is an element of risk in the work. The operator might lose his fingers or a hand if his movements were not accurately coordinated. The work could be learned in a few weeks. Wages range from \$20 to \$25 a week.

Putting Bristles into Metal Plates. The most economical method for putting bristles into toilet brushes is a mechanical one. The bristles are put in a hopper at the top of the setting machine. Through a screen in this hopper they are shaken down on a die which holds a perforated plate. Perforations in the die correspond accurately to those in the plate or block, but they are tapered so that

the larger end is at the top. By constantly agitating the hopper the bristles are gradually shaken into the holes in the die. Those that are not caught by the die fall to a pan at the bottom of the machine, and are automatically carried back to the hopper. When all the perforations in the metal plate have been filled it is sent to the cementing room. Operators of these machines are commonly women. The worker must be fairly active with both hands and legs, though there is no very heavy lifting. It is possible that a man who had lost a leg below the knee could engage satisfactorily in this operation. Loss of two or three fingers, hernia, or defective hearing would also not prove serious handicaps. The work could be learned in two or three weeks. Wages usually range from \$18 to \$25 on a piece basis.

Cementing Bristles. After the bristles have been set in place, cement is poured over the back of the metal plate filling in the concave portion of the plate. The work of cementing involves a number of minor operations which seem to be done best by delegating each to an operator and arranging the group on a team-work basis. The various operations are:

1. Inspecting and pounding in bristles.
2. Burning bristle ends to give them greater adhering qualities.
3. Clamping molds.
4. Pouring cement.
5. Taking off molds.
6. Grinding rough edges of cement after pouring.

Most of this work is fairly heavy and demands constant activity. It is possible that inspecting and grinding of cement could be done by a man who had lost a leg. In the other operations the worker should be able-bodied with the possible exception of the loss of one or two fingers, hernia, or defective hearing. All the operations in the

menting department can be learned in a comparatively short time, though several weeks' experience would be necessary before the operator could acquire a maximum of efficiency. Wages are about \$25 a week.

Assembling Toilet Brushes. Where the back and bristle surfaces are made separately, it is necessary to assemble the two parts of the toilet brushes. This work is commonly done by girls who are seated at their work at tables. The work consists of fastening the brush together with cement. The work is light, and it could easily be done by a man who had lost a leg, providing the material was carried to and from his bench. Loss of two or three fingers, heart trouble, hernia, certain nervous disorders, stiffness of trunk muscles, and also defective hearing would not prevent one from engaging in this operation. The work could be learned in two or three weeks. The wages vary from \$12 to \$14 a week.

TOOTH-BRUSH MANUFACTURE

In general this report will follow a particular method of toothbrush making characteristic of work done in this country. Other methods will vary in detail from this, though involving very similar operations as far as handicapped workers are concerned.

Molding Tooth-brush Handles. Tooth-brush manufacturers in this country commonly use pyroxylin plastics for making handles. This form of handle permits of molding to special shapes by simple processes. The handles are generally prepared in the form of blanks which are simply rectangular sticks of pyroxylin plastic. These blanks are placed in iron molds and heated under pressure. This forms the blank into the shape desired for the tooth-brush handle. The molds employed usually contain a half dozen cavities. The worker heats his blank on a plate before putting it into the mold. The mold is then placed be-

tween the plates of the press where it is allowed to remain for a short time. This work must be done standing, as the operator is required to move constantly between his work bench and the press. Aside from the lifting of the molds, which are not very heavy, the work is light. There is a certain amount of heat from the press, though this is not at all excessive. It is possible that an active man who had lost a leg below the knee could do this work, provided his artificial leg would permit him to stand constantly. The loss of two or three fingers, hernia, or defective hearing would also not prove serious handicaps. Six or eight weeks' experience would be necessary to acquire a maximum of efficiency. The wages are usually on a piece basis and are about \$22 a week, a single worker turning out about 2,000 handles a day.

Removing Rough Edges from Tooth-brush Handles and Polishing. In connection with the finishing of the tooth-brush handles there are a number of minor operations which vary slightly as to method in different places. Where the handle has been molded in the manner described, there are rough edges along the handle at the point where the two halves of the mold have come together. These rough edges are removed by first scraping the handle with a knife. The final surface is obtained by buffing the edges. The scraping is done by women working at tables, and the requirements for this work are the same as in the case of other light, seated operations where the hands are necessary. The work can be learned in an hour's time, though rapidity in manipulation requires several weeks' experience. The wages vary from \$12 to \$18 on a piece basis. The work of buffing is usually done by men who are seated at their buffing wheels. The operation involves very rapid manipulation with the hands. One workman does as many as a thousand handles a day on a piece work basis. Loss of leg, hernia,

certain trunk disabilities, or defective hearing would not prove serious handicaps. The worker should have the use of all his fingers, as they play a very important part in the operation. Wages are about \$22 a week.

Polishing is similar to grinding, except that a final buffing-wheel is used. The physical requirements and wages are practically the same as those for grinding.

Reaming Holes in Handles. In the case of some tooth-brushes a hole is made at the end of the handle for hanging the tooth-brush. The impression for this hole is molded in the handle, but it is not possible to prevent a film of the material from forming over the hole. This must be drilled out. The work is usually done by girls on a piece basis. As in grinding and polishing processes, rapidity of manipulation is essential. As the work could be done seated the loss of a leg would not prevent one from engaging in this operation. Hernia, certain trunk disabilities, or defective hearing would also not prevent one from doing this work. The wages vary from \$12 to \$16 a week on a piece basis.

Putting Bristles into Tooth-brush Handles. After the handles have been ground and polished, they are ready to have the bristles put in. The most popular method in this country is that of stapling. In some cases the holes for the bristles are bored with a drilling machine, and the bristles are stapled in a stapling machine. The more modern method is to combine the two operations on a single machine. The operation of this machine is similar to the operations of the machines where the boring and stapling are done separately. The latter only will be described. In the drilling and stapling machines a dozen or more tooth-brush backs are placed in clamps on a small endless belt which operates in a vertical plane. Each tooth-brush in turn passes before a drill which bores the holes for the bristles. After these have been made, the handle is moved up to the stapling device. This mech-

anism selects the proper amount of bristle from a small tray at the side of the machine and carries the knot to a point directly opposite the hole to be filled. A small staple is driven into the hole and over the bristles. The bristles are doubled, so that the curved end is at the bottom of the hole and the staple fits firmly over the center of the curve. This machine operates very rapidly, so that although each hole must be filled separately, a tooth-brush is turned out complete in about a minute's time. The chief work of the operator is to place and move the handles and see that the bristles do not clog in the machine. Where serious difficulties arise a mechanic is usually available to adjust the machine. For at least a portion of the time the worker could remain seated, so that the loss of a leg below the knee, loss of one or two fingers, hernia, or defective hearing would not prove serious handicaps. Three or four weeks' time is sufficient to become familiar with the operation. The wages are about \$20 a week, commonly on a piece basis.

Miscellaneous Operations in Finishing. There are a number of minor operations through which the tooth-brush must pass after the bristles have been put into the handle. In many cases the trade name is put on the handle. This may be done by a transfer process, in which a lacquer is put over the printing to prevent it from rubbing off. Where a slight curve is put in the handle it is necessary to heat it slightly and to allow it to cool after having been pressed into the desired form. Where a special shape is desired in the bristles, these are trimmed at a machine containing a series of revolving knives. Before the brushes are packed they are frequently cleaned by a vacuum process. In the process of manufacture both the bristles and the handles usually pass through a number of inspections which are similar to the final inspection. These inspections have not been spoken of

in detail because of their likeness. Where the toothbrushes are packed in individual boxes, this work also offers employment of a simple form. All of the operations described under this section are comparatively simple. Most of the work can be done seated for part or all of the day. The chief requirement is rapid and accurate movements of the hands, and in case of inspection operations, a knowledge of and careful attention to certain definite standards. Women are employed for most of this work, though in the case of trimming and inspection some men are also used. The loss of one leg would not prevent one from engaging in any of these operations, and in most cases a worker who had lost both legs would not be disqualified. The fingers are particularly important, though in some cases the loss of one or two fingers might not be a serious handicap. Where the operation was not carried on with the assistance of mechanical devices, heart trouble would not prevent one from engaging in this operation. Hernia, certain trunk injuries, or defective hearing would not be serious handicaps. The wages vary from \$12 to \$20 a week. The operations for men usually pay a somewhat higher rate.

BRUSH MANUFACTURING FIRMS IN DIFFERENT STATES

CONNECTICUT: Wallingford
Wallace & Sons

ILLINOIS: Chicago
Gerts Lombard & Co., 208 Randolph Street

INDIANA: Indianapolis
Indianapolis Brush & Broom Manufacturing Co.

MARYLAND: Baltimore
Bigelow Brush Co., 116 South Register Street
Rennous Kleinle & Co., 848 Frederick Street

MASSACHUSETTS: Boston
A. & E. Burton & Co., 73 Pearl Street
J. C. Pushee & Sons, Randolph and Harrison Streets
John J. Whiting. J. J. Adams Co., Harrison Avenue

MASSACHUSETTS: Florence
Florence Manufacturing Co.

MISSOURI: St. Louis
Sanitol Chemical Laboratory Co.

NEW JERSEY: Arlington
E. I. DuPont, DeNemours & Co. The Arlington Works

NEW JERSEY: Newark
Rubberset Co., 60 Ferry Street
John L. Whiting, J. J. Adams Co., 122 Greenpoint Avenue

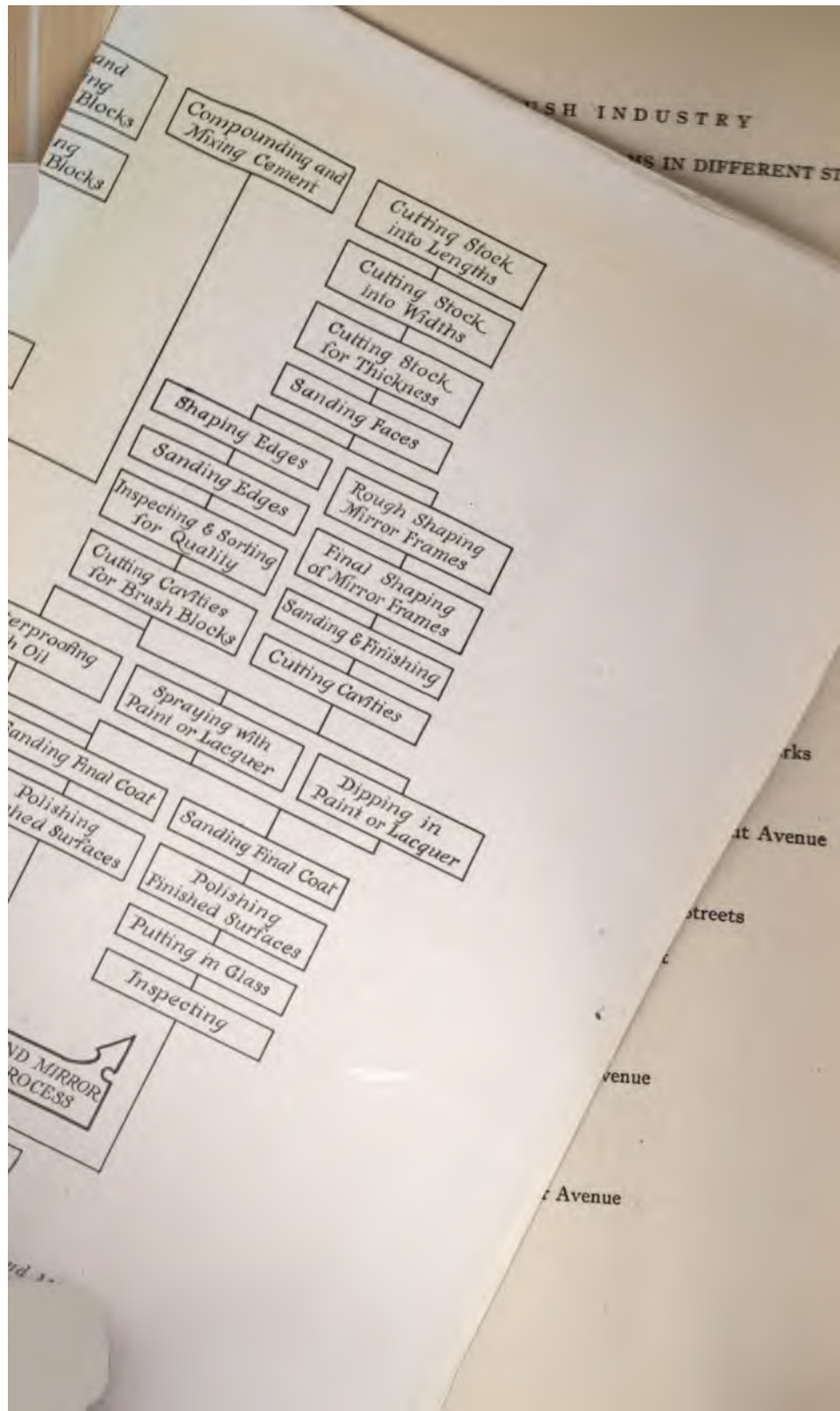
NEW YORK CITY
Bradley & Smith, 251 Pearl Street
Devoe & Reynolds Co., Fulton & Williams Streets
Hanlon & Goodman, 270 Pearl Street
J. M. C. Martins Sons, 116 William Street

NEW YORK: Rochester
Shinolo Co., 8 Jay Street

OHIO: Cleveland
Osborn Mfg. Co., 5401 Hamilton Avenue

OHIO: Wooster
Wooster Brush Co.

PENNSYLVANIA: Pittsburgh
Wolfe Brush Co., 1805 Beaver Avenue



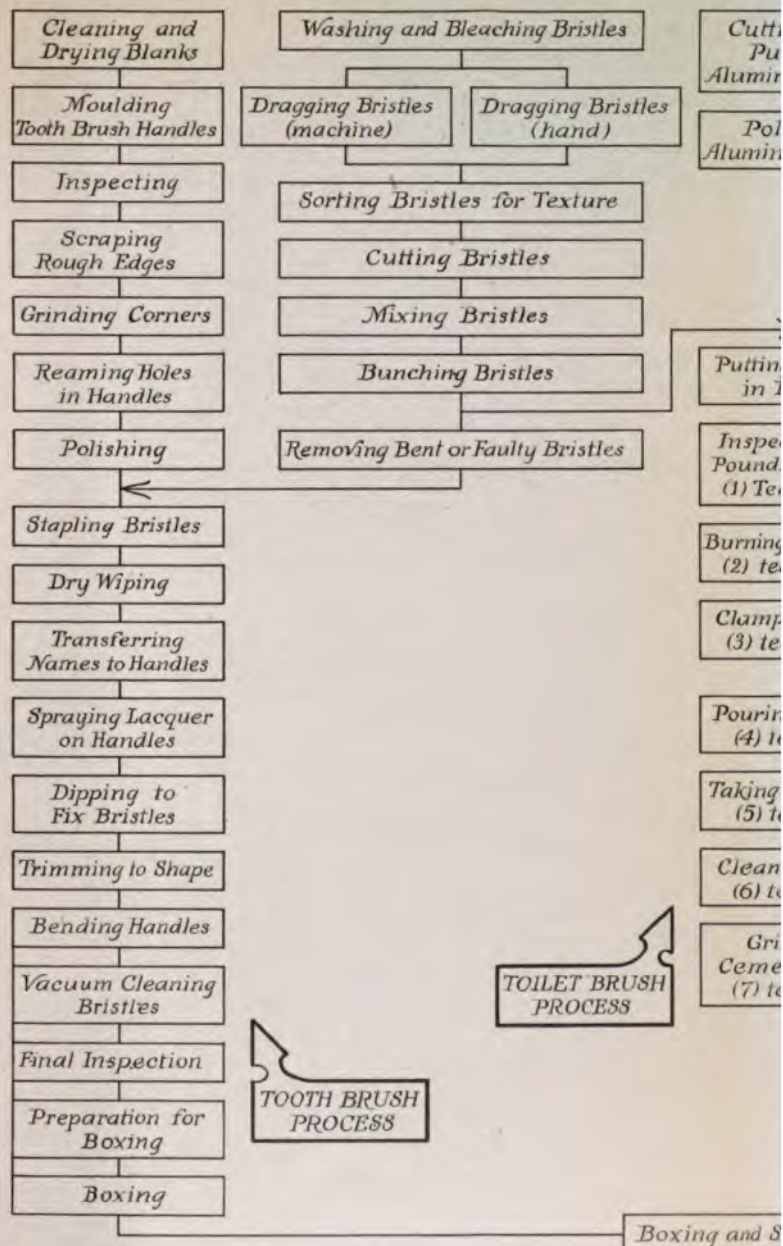


Chart Showing Principal Operations Carried on in a Modern F

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Bibliography

Very little has been written in English on the brush industry. Encyclopedia articles are, of course, available. Various census reports supply statistical material. The most valuable of these have been issued by the United States, Canada, Great Britain, France, Germany, and Japan. In 1918, the United States Tariff Commission published a booklet entitled *The Brush Industry*. This booklet contains a brief discussion of the present condition of the brush trade, together with a considerable amount of statistical material relating to the brush industry both in this country and abroad. Below is given a list of some other reference material at present available:

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Census of Manufactures. Canada.

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1. The first part of the document is a list of names and titles, including "The Hon. Mr. Justice" and "The Hon. Mr. Justice".

List of Operations as Related to Disabilities

<i>Loss of Leg</i>	<i>Page</i>	<i>Loss of Leg (Cont'd.)</i>	<i>Page</i>
Bending Ferrules (below knee)	34	Removing Rough Edges from	
Buffing Ferrules	38	Tooth-brush Handles	46
Bunching Bristles	23	Sanding (below knee)	40
Cementing Bristles (below		Sanding and Polishing	42
knee)	28	Shaping Brush Backs (below	
Cutting Cavities in Brushes		knee)	40
(below knee)	41	Soldering Ferrules	35
Cutting Stock for Backs of Toi-		Spraying	42
let Brushes (below knee) . .	39	Stamping Holes (below knee) .	35
Cutting Tin (below knee) . .	34	Tying, Dipping and Setting .	26
Dragging Bristles (one or both			
legs)	20	<i>Loss of Arm</i>	
Drawing Bristles	25	Nailing Ferrules to Handles	
Fitting Handles to Small		(below elbow)	36
Brushes	37	Setting Bristles in Rubber . .	32
Gumming Bristles	29	<i>Loss of Hand</i>	
Knot-Making	28	Nailing Ferrules to Handles . .	36
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Ends	30	<i>Loss of Fingers</i>	
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(below knee)	45	Cementing Bristles	28, 44
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Putting Bristles in Cones . . .	18	Cutting Cavities in Brushes . .	41
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Putting Bristles into Tooth-		Dragging Bristles	20
brush Handles (below knee)	47	Drilling Holes in Backs	24
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<i>Loss of Fingers (Cont'd.)</i>	<i>Page</i>	<i>Defective Hearing (Cont'd.)</i>	<i>Page</i>
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Planing Stock	39	Fitting Ferrules to Oval and Round Brushes	30
Putting Bristles into Metal Plates	43	Fitting Handles to Small Brushes	37
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Shaping Brush Backs	40	Molding Tooth-brush Handles .	45
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Ref.
Publications of the Red Cross Institute for
Crippled and Disabled Men

Edited by Douglas C. McMurtrie

ies 11

May 15, 1919

Number 8

Opportunities for the Employment
of Handicapped Men in the
Shoe Industry

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Bureau of Vocational Guidance
Division of Education
Harvard University

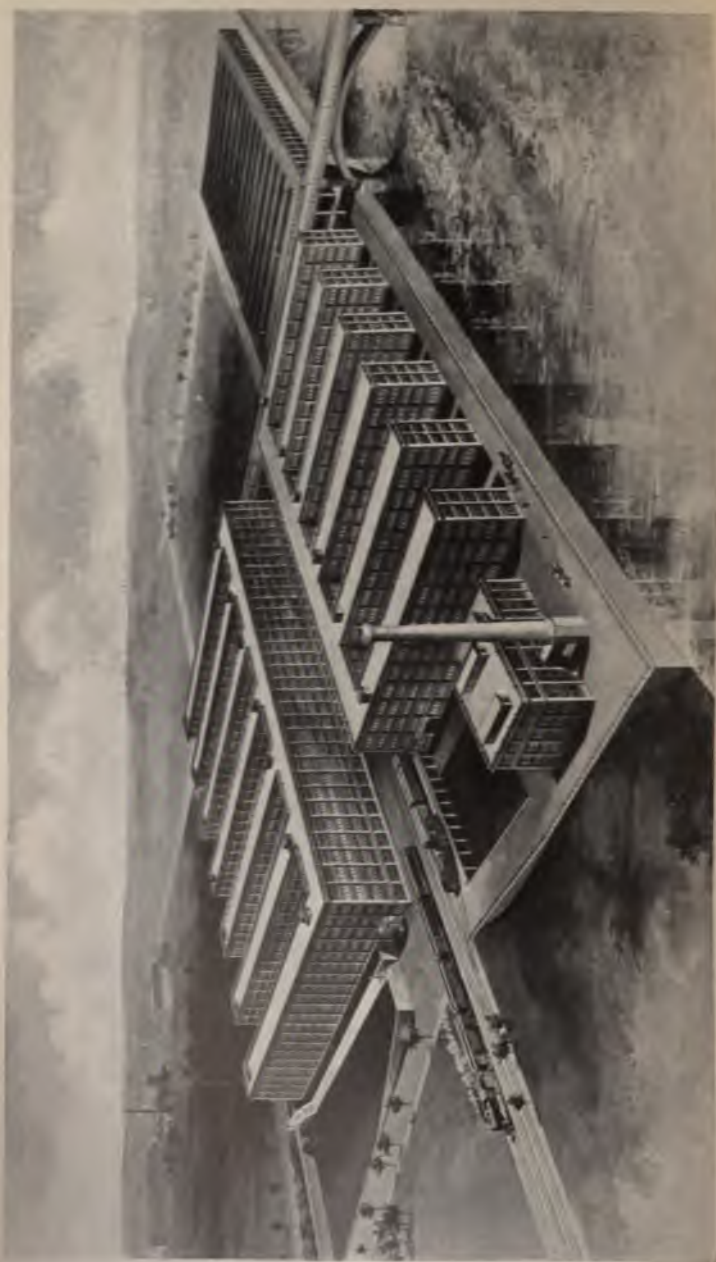
Author of
"The Shoe Industry"

Prepared by the
Bureau of Vocational Guidance
In cooperation with
Red Cross Institute for Crippled and
Disabled Men, New York

The Red Cross Institute for Crippled and Disabled Men
311 Fourth Avenue New York City

**Opportunities for the Employment
of Handicapped Men in the
Shoe Industry**

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By courtesy of the McElwain Co.

A typical modern shoe factory: plant of the William H. McElwain Company, at Manchester, N. H.

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Preface

THE material embodied in this Bulletin, which is one of the series being prepared by the Harvard Bureau of Vocational Guidance for publication by the Red Cross Institute for Crippled and Disabled Men, is the result of an intensive study of the boot and shoe industry by the author through a period of years. A more complete presentation of the subject is to be found in 'The Shoe Industry', by the same writer, published by the Bureau of Vocational Guidance of Harvard University. The reader is referred to that volume for the history of shoe-making, methods in last-making and pattern-making, leather and tanning, numerous statistical tables, a glossary of shoemaking terms, and a more minute treatment of the general processes of boot and shoe manufacture.

The purpose of this Bulletin is to present a brief but adequate survey of the industry and its opportunities for handicapped workers. Extensive fresh information, therefore, has been secured from shoe manufacturers, business executives, factory superintendents, foremen, trade instructors, efficiency experts, consulting engineers, shoe machinery inventors, machine operators, and others. The conclusions and statements regarding opportunities for the handicapped which appear in the following pages have been read and approved by the same authorities. Thus, although not many handicapped persons have entered the industry as yet, and any statement must in a sense be tentative, the conclusions here presented have the weight of consensus of expert opinion.

The wages here given are neither those of 1914 nor the abnormal wages of war. They are an estimate of the

probable earnings of workers in the shoe factories in peace times following the war, and are based upon information from wage authorities of high standing.

Among the many who have cooperated with the writer in the preparation of this Bulletin, special acknowledgment is due to the following:

Mr. THOMAS F. ANDERSON, *Secretary of the New England Shoe and Leather Association*, which through its Committee on Industrial Education has approved and furthered the work.

Mr. J. B. HADAWAY, *Consulting Engineer of the United Shoe Machinery Corporation*, who has supplied the illustrations of the Bulletin and aided in other ways.

Professor GEORGE E. JOHNSON, *of the Division of Education of Harvard University*, who has visited shoe factories in checking up material and has also contributed valuable suggestions.

FREDERICK J. ALLEN

Harvard University
November, 1918

I. The Employment of Handicapped Men in the Shoe Industry

MANY of the minor processes of shoe manufacture and a considerable number of the major processes can be performed by handicapped men. The industry offers numerous opportunities for such workers to earn a fair living or even high wages and salaries. Its 1400 factories are established in all sections of the country, and each factory employs hundreds or thousands of operatives. The place, moreover, of the industry is among the great staples whose products are in ever increasing demand. Such industries must have workers, and must, if necessary, modify their processes to the abilities and condition of the workers who will be returned to employment after the war.

Shoe manufacturers are ready to employ men who return with disabilities. If such men have formerly been employed in the industry they can enter it again the more easily; if they have not done shoe work, they can learn some part of it in a comparatively brief time. The employer in the great shoe centers especially will welcome the returned soldier, who will have on the whole good mental ability. It is now necessary in these places to hire considerable alien help, which has only an economic interest in the service it performs. Furthermore, the employment of handicapped men in the shoe factory will lessen the increasing danger of an over-employment of women in the harder and more wearing divisions of the occupation.

The view of the manufacturer is well expressed in the following statement by the superintendent of one of the great factories in the vicinity of Boston, when the inves-

tigation of opportunities for the handicapped was going on in this factory:

Work here depends on the man more than on freedom from handicap. A person willing to take hold and learn may do something with almost any handicap. An operative here who loses several fingers or a thumb may keep his place on almost any job. So one blind in one eye may still work; those deaf and dumb may work here successfully. We have this morning hired four inexperienced men who are both deaf and dumb. They will be put upon machines and trained as shoe workers.

Of specific disabilities it is necessary here to speak but briefly. Loss of legs will not incapacitate a man in the industry. He may work at many operations sitting. Plans are now being considered to construct seats and benches for some of the heavy shoe machines at which the operator now stands. The great problem will be to enable the man who has lost one or both hands or arms to operate shoe machines or do hand processes in the factory. A man of general strength and health who has almost any injury except in hands and arms may become a shoe operator. Manufacturers and inventors of shoe machinery are now considering methods of adapting shoe machines to handicapped operators by means of mechanical devices, air pressure, and electrical devices. Where now a foot pressure of eighty or one hundred pounds is used on the treadle of a heavy machine, by possible and contemplated improvements this pressure may be reduced ninety per cent., or the machine may even be operated by touching an electric button. Mr. J. B. Hadaway, consulting engineer for the United Shoe Machinery Corporation, made the following wisely conservative statement, expressly for this section of the Bulletin:

I think it possible in time to so arrange the machines that the difficulties which would be experienced by operators with crippled limbs will be partially overcome.

This is the statement of a leading authority in a great corporation which manufactures and leases shoe machinery for the bulk of the industry in this country today.

The conservative point of view upon the employment of handicapped men in the shoe industry may properly be presented here, that we may the better understand the industry and more intelligently estimate its opportunities for workers who have disabilities of any kind. Shoe manufacture is highly specialized and its operations are mainly performed on standard machines. The best paying operations are upon machines that call for the full strength of a person standing while at work, and require two good hands and two legs, healthy lungs, and strong chest muscles. There is also a great deal of moving about at most jobs, to do one's own work and pass it to the next operator, and quickness of movement and speed of machine are necessary for profitable earnings for the individual worker and for a satisfactory output in a factory department. It is just as necessary for a piece worker to work fast as for a day worker, since he must keep up to the rate of speed required by workers associated with him. All shoe parts being worked upon pass through one room after another on scheduled time, and no operative can be allowed to fall behind others. The shoe factory as a whole is no more efficient than the weakest link in the chain of workers.

As most operations are paid by the piece, the handicapped worker might receive lower wages, since no factory would increase its rate. It might become necessary, then, in part, to employ handicapped persons upon the less skilled operations now performed by women and girls, or boys, at wages paid to these workers. This would displace such workers in a degree, even if shoe manufacturers were willing to make the change; but manufacturers prefer women, girls, and boys for most of

the work which they now do on account of their skill of hand, quickness, or steady application to their work. Women, in particular, are being employed in increasing numbers in the shoe factory upon the processes previously performed by men. In general, the output of these women is proving greater than that of men formerly in the same processes, and a return to the earlier relative numbers of the sexes in the industry is not to be expected.

Mr. Sidney W. Winslow, Vice-president of the United Shoe Machinery Corporation, makes the following statement:

Ninety per cent. of our machinery calls for the use of both hands in holding the shoe up to the machinery in such a position that the machinery may operate upon the shoe step by step along the contour of the shoe, which means that the operator has to turn the shoe by hand and needs both hands to do so. This would, of course, prevent most of the hand cripples from being able to use 90 per cent. of our machinery.

At most of our machines the operators stand while running them. Our Experimental Department has been going through our machines thoroughly with the idea of arranging that the operator may sit and operate these machines, having in mind the possibility of woman labor. This, of course, would make it possible for the leg cripples to run these machines.

These machines represent investments of millions of dollars and priceless patents. In some cases there are thirty or forty patents on a single machine. Changes in the machines, therefore, will come very slowly, and generally only in the line of the perfection of a process.

Certain conclusions in regard to the problem of the employment of handicapped workers in the shoe industry are here presented:

1. Opportunities exist to a considerable degree in the major and to a large degree in the minor factory processes and in shoe repairing.

2. In the present scarcity of intelligent labor, employers will welcome the handicapped worker who desires to enter the shoe factory.

3. Leg handicap will not incapacitate a person for shoe work. The man with one artificial leg may stand at a machine; one with both legs gone or artificial may work sitting, especially after projected changes in machinery.

4. The main problem is one of hands and arms. Most of the processes in shoe manufacture require two good hands. Passing from early hand shoemaking to present machine shoemaking only adds intricacy to processes.

5. Defective sight and serious bodily injury constitute decided handicaps.

6. Minor injuries and the loss of several fingers are practically negligible handicaps.

7. Shoe machinery is standardized. The main processes are fixed and demand workers who are vigorous, active, and capable of endurance.

8. Shoe machinery is based upon thousands of costly patents and represents millions of dollars in investments. Changes for any one particular class of workers are likely to come slowly.

9. Handicapped men should be well trained and placed on shoe processes where they will be 100 per cent. efficient as compared to other operators. They can expect to remain in the shoe factory permanently only on this basis.

The specific kinds of disabilities with which this Bulletin, like others in the series, deals, are the following:

- | | |
|-----------------------|-----------------------|
| 1. Legs | 9. Pulmonary diseases |
| 2. Arms | 10. Heart diseases |
| 3. Hands | 11. Hernia |
| 4. Fingers | 12. Skin diseases |
| 5. Defective sight | 13. Paralysis |
| 6. Defective hearing | 14. Ankylosis |
| 7. Nervous disorders | 15. Other handicaps |
| 8. Trunk disabilities | |



The Early American Shoemaker

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II. A Modern Shoe Factory

It is a far step from the ten-by-twelve, one-story shoemaker's shop of the middle of the last century to the great concrete structure which houses the modern shoe factory. True, there are many wooden factories in our older shoe centers, but they were built twenty, or thirty, or forty years ago—before the age of steel and concrete. American shoe manufacturers are now erecting the finest and largest shoe factories in the world, profiting by the developments in building construction in the Old World and in the New.

The shoe manufacturer seeks a locality that is accessible by railway, on or near some main line of traffic, that he may bring in his raw materials and distribute the manufactured product with as little cost and delay as possible. It is an advertisement to him to be located in a well-known industrial center. Frequently he is granted exemption from local taxation as an inducement to enter a town.

The securing of workers constitutes the greatest problem of the manufacturer. He seeks a community out of which he may secure factory employees, without competing with other industries to his disadvantage in the scale of wages. The older and leading shoe towns, therefore, like Lynn and Brockton, Mass., are essentially one-industry towns. The shoe factory in the large city obtains employees from the great number of industrial workers to be found there, and suffers from the mobility of labor. The factory in the small town or country community draws its workers from the rural districts and profits by the inertia of labor. And the large shoe factory continually attracts operatives who have learned their trade in the smaller factory.

Let us, then, view a typical modern shoe factory in an industrial community. We find it upon a main or spur railway line, and upon one or more public thoroughfares, convenient to traffic and accessible to employees. At the rear of the building is a sizable park, with shade trees, flowers, shrubbery, and settees for employees during rest hours. A club house and athletic field for male employees are among the features which make industrial employment attractive to workmen. All these advantages, with others maintained in the factory itself, contribute to the home feeling and factory pride and spirit of the employees. They create solidarity in factory life. They signify the mutual getting together of employer and worker. They make out of industry a means of social and personal growth.

Turning to the factory itself, we observe its massive, yet window-covered structure. It consists of a steel frame covered with concrete, the gray garb of modern industry. This building has the typical, standardized form that has been developed in the shoe industry. Light is the most important consideration. The width of the building is limited to about fifty feet, so that there may be plenty of light along the middle of each room. This plan allows ample space for the economic placing of machinery. In this factory no space is lost. Some shoe factories in European countries have but one story with glass roof, so that the light falls clearly upon all parts of the floor, thus necessitating extensive ground space. Our American building, economizing ground space, gets light from the sides, but usually has a special system of windows in the roof for the benefit of the upper floor.

This typical shoe factory is a single building about three hundred feet long and four stories in height. Sometimes there are wings at the ends of the main building of the same height and width as the main structure. The length

varies from two hundred feet up to several hundred and some factory systems are as much as a quarter or half-mile long. Such large plants employ four or five thousand people, and turn out fifteen to twenty thousand pairs of shoes a day. Some large factories have seven or eight floors, but usually because of lack of ground space or because of having been built before the standard plan was fixed.

The power plant is installed in a one-story building on one side of the factory. Steam is generally used to generate power and furnish heat, and electricity for lighting purposes. In some factories electricity furnishes the motive power also. This building is equipped with an automatic alarm, freight and passenger elevators, stairways, and fire escapes. It has an extensive locker system, and the latest sanitary equipment throughout. An exhaust fan system is used to draw the dust and dirt from the abrasive and trimming machines used in the different departments. This dust material is conveyed to a receptacle near the power house, where it is burned in the furnace.

The four-floor system of the factory is found to be the most convenient for the sequence of processes in manufacture. The four floors provide space for the six major departments of manufacture and for the business offices. The sole leather department, which prepares the bottom parts of the shoe, occupies the first or basement floor. The upper leather and stitching departments occupy the fourth or upper floor, where it is always possible to obtain plenty of light. In these departments the leather upper parts and linings of the shoe are cut out and sewed together and made ready for attaching the bottom. The making or bottoming department uses most of the third floor. Here the sole leather parts and leather tops and linings are brought together and the shoe is made ready for finishing.

The finishing, packing, and shipping departments are upon the second floor. All of these divisions of the factory are described at length in the sections which follow. The business offices are usually divided between the second and third floors, while the factory offices are associated with factory rooms when possible.

A very large shoe manufacturing company may have a system of buildings grouped about a common center, which may be a separate administration building or the oldest or main factory building. In such a system the sole leather department usually occupies an entire building, preparing sole leather parts for the other manufacturing departments. Another building is usually given up entirely to making men's shoes, another to women's shoes, and so on, according to the special lines followed by the concern. There may also be a box factory, saw mill, printing plant, or other subsidiary department attached to the group of buildings. In some cases a large concern has central offices, or a central factory, in one locality, and the separate factories in other localities.

It remains to speak of the neighborhood of the shoe manufacturing plant. This neighborhood tends to become a factory community, as time passes. Shoe operatives with families wish to live near their work, and frequently several members of a family work in the same factory. Car fares then become an item of importance. The family accordingly lives near enough to the factory to walk back and forth and to come home for lunch at noon time. On the other hand the manufacturer prefers to hire those who live near by, as they can the better be depended upon to remain steadily and permanently in his employ.

III. The Magnitude of the Shoe Industry Today

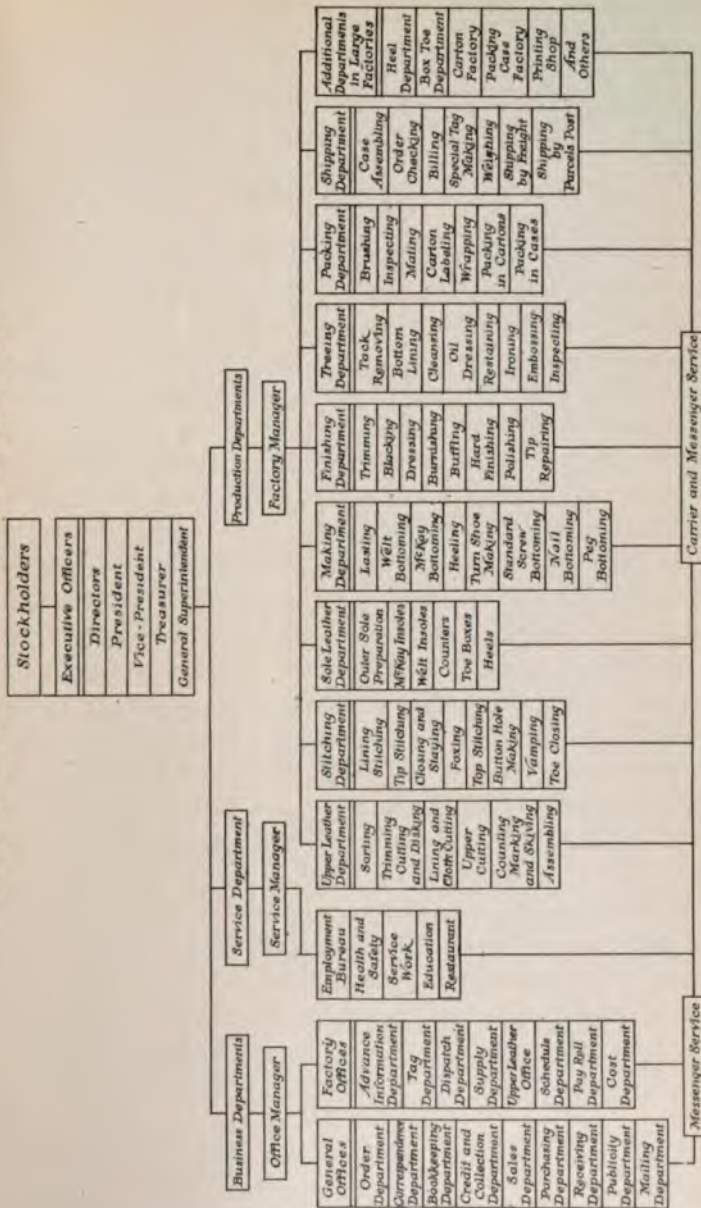
The growth of the manufacture of boots and shoes in this country has been remarkable. The greatest gain has taken place within the last twenty-five years, or since the invention and general use of the more important shoe machines. There are now about 1,400 factories making boots and shoes only, and about 600 factories manufacturing allied products, in more than thirty states of the Union. The leading states in their order are Massachusetts, Missouri, New York, New Hampshire, Ohio, Pennsylvania, and Illinois. The capital invested in the entire industry is now in the neighborhood of \$500,000,000, and the number of employees in the factories is probably about 275,000. Boston is the leading center of the world in the shoe and leather trade; Chicago, in trade in untanned hides. Lynn, the first home of the industry in this country, was long the leading city in the manufacture of shoes and shoe material. It now leads in the manufacture of women's shoes. Brockton, Mass., stands first in the manufacture of men's footwear. Other cities in the order of magnitude of the production of shoes are St. Louis, Mo., Haverhill, Mass., Boston, New York, Manchester, N. H., Cincinnati, Rochester, N. Y., and Chicago.

Before the war \$100,000,000 was spent annually in this country in shoe repairing, which has grown rapidly into a machine industry. It is now estimated that the yearly earnings of this industry are fully \$300,000,000, in addition to an extensive sale of shoe findings.

The exportation of American-made shoes has come within the last twenty years. The United States is not

only leading the world in shoe manufacture, but is finding markets increasingly in all countries. At the opening of the European War we were exporting shoes to over ninety foreign countries. In the years of peace following the war, with the remarkable revival of our merchant marine, our foreign trade in all lines will surpass all former bounds and ambitions.

CHART of ORGANIZATION in the SHOE INDUSTRY



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IV. The Organization of a Shoe Factory

A modern shoe factory has three lines of business activities associated with it—executive control, maintenance of business, and maintenance of manufacture. Service management, which includes the recruiting, training, promotion, and care of the health and personal welfare of employees, is usually grouped with the three major divisions, but in a sense is independent of them. The chart on page 27 presents under 'Executive Officers' and 'Business Departments' the activities of the business side of a modern shoe factory. From fifteen to twenty per cent., or nearly one-fifth of the persons connected with the shoe industry, are employed in the work of these divisions.

The usual executive officers down through the list are: Directors, president, vice-president, treasurer, and superintendent or general manager. The functions and duties of the executive officers and their assistants in shoe manufacture are the same as are found in the general business world. They originate and control plans and policies for the conduct of business and manufacture.

The activities of the general offices reach out into the world of trade. They maintain the business relations of the factory. They handle the orders received from retail dealers and agents, attend to correspondence and book-keeping, purchase and care for material, advertise and sell manufactured goods, determine credits, and make collections.

The factory offices are concerned closely with manufacture, touching the factory at every department. They are usually separate from the general offices and placed in

or near the departments of the factory where work is actually done. They take charge of tags made from the orders received by the order department and follow them through the factory. They provide a schedule of the time in which shoes shall be made or passed from room to room. Briefly, they maintain control over manufacture in the factory.

The production departments are divided into six leading general divisions in the modern shoe factory, as follows: Upper leather department, stitching department, sole leather department, making department, finishing department, and the treeing, packing, and shipping department. These are each minutely subdivided into factory rooms, sections, or departments. In large factories we find numerous additional divisions, such as heel department, box toe department, and box factory.

Other names are sometimes used for some of these divisions. For instance, the stitching department is sometimes called the fitting department; the sole leather department, the stock-fitting division; and the making department, the bottoming department. For the sake of brevity in speaking, the word 'room' is very generally used in a shoe factory for department. The divisions of factory manufacture appear in the accompanying diagram under the heading 'Production Departments'.

The organization of the shoe factory has become standardized with the great development of the industry in recent years, and the accompanying chart presents this standard form of organization. Here appear, in their natural sequence, the divisions of executive control, business, employment service, and factory production. The subdivisions in each section are arranged in the order of the work done or of the special processes of manufacture.

V. Methods in Shoe Manufacture

The various methods used in manufacturing shoes are a result of the introduction of machinery into the industry. Before the introduction of shoe machinery, all sewing upon shoes, both the fastening of the bottom of the shoe to the upper as well as fastening together the parts of the upper, was done by hand. Indeed, it was the early custom in shoe factories to allow people to take parts of shoes from the factory to their homes for hand stitching. The great break between shoemaking as a hand industry and shoemaking as a machine industry came with the period of the Civil War. The chief difficulty in the making of shoes and some of the early important improvements had to do with the attaching of the sole to the upper. From the methods used in fastening together the sole and the upper of the shoe we have the following divisions, each indicating both a kind of shoe and a special method of manufacture:

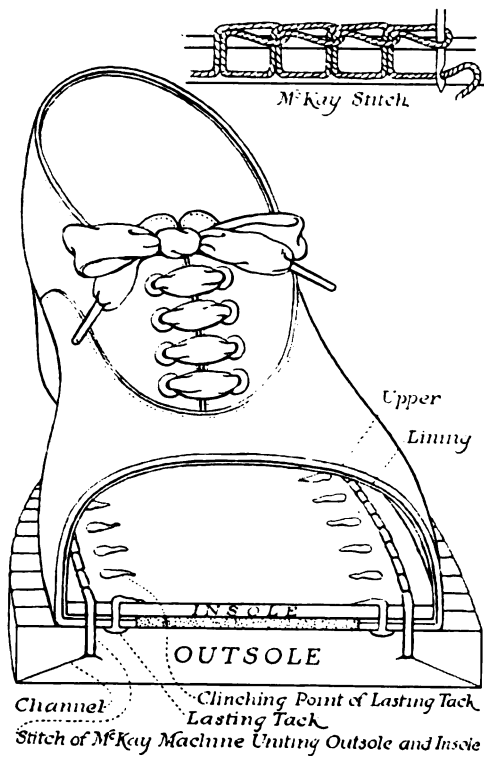
The Goodyear Welt	The Standard Screw
The McKay	The Pegged
The Turned	The Nailed

Most factories confined themselves to making one or two kinds of footwear, or to using one or two of these methods in boot and shoe manufacture. One manufacturer is known as a maker of Goodyear welt shoes, another of McKay shoes, another of nailed shoes, and so on. The lighter kinds of shoes, those worn by men in civilian life and those worn by women and children, are the Goodyear welt, McKay, and turned. The heavier grades, especially those made for outdoor wear by farmers,

fishermen, and soldiers in some countries are made by the pegged and standard screw methods. The McKay method, by which the bottom of the shoe is sewed to the upper, the stitches passing directly through both outer and inner soles, has been used very extensively in the medium weight and cheaper shoes for many kinds of wear. The Goodyear welt has been used more and more widely for the medium and better grades and is the process of leading importance at the present time. By this process the sole of the shoe is sewed to the upper by means of a welt, making a flexible, comfortable shoe that may be easily and frequently repaired. The turned shoe method is used in making fine shoes and slippers for women and children. The shoe, which must be of flexible leather, is made wrong side out and then turned right side out. Wooden pegs and nails were long in use, leading to the method of the 'standard screw', in which the nail has become a piece of wire with screw threads upon it.

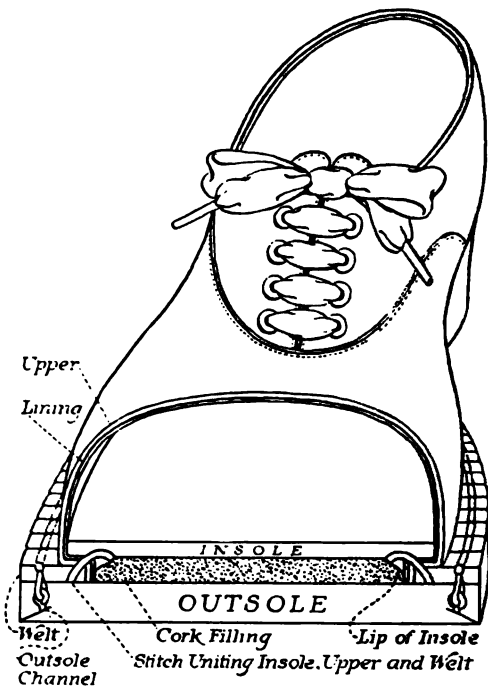
Although the exact figures are not available, it is probable that at the present time the machine or hand-welt method produces about forty per cent. of the boots and shoes made in this country; the McKay method, about thirty-five per cent.; the turned method about fifteen per cent.; the standard screw and nailed methods, about eight per cent.; and the wooden pegged, about two per cent. We shall consider all these kinds of shoes and methods of manufacture frequently in the following pages.

The Goodyear welt method will interest us most because of its increasing importance in industry. It may be regarded as typically representative of American shoe-making. Various parts of the Goodyear welt shoe are the same as in most other shoes, aside from the welt. As seen in the process of making, they are the following:



Cross section of a McKay sewed shoe

While this is a sewed shoe, it differs radically from those made by the Goodyear welt process, inasmuch as the lasting tacks and a line of stitches appear inside. It is the method very generally employed in making the cheap and medium grades of shoes.



Cross section of a Goodyear welt shoe

This diagram shows the ingenious method employed in constructing this now widely worn type of shoe, which is perfectly smooth inside. The tacks used in lasting are all withdrawn, and a machine with a curved needle sews the welt and shoe upper to the insole without going inside the shoe. The heavy outsole is then stitched to the welt. The thread used is of the strongest linen and thoroughly waxed. It makes the most durable and comfortable type of shoe, and one on which the outsole can readily be renewed.

The excellent qualities and popularity of the welt shoe have led to many imitations of it in the McKay method.



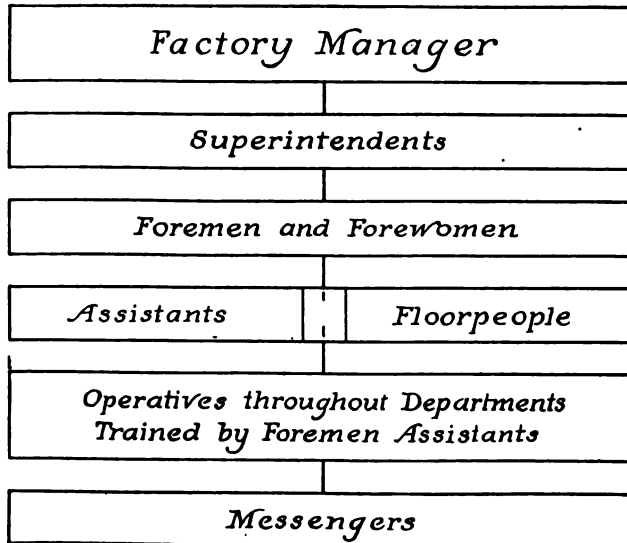
*A Goodyear welt shoe in the different stages
of manufacture*

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1. The last.
2. The upper.
3. The sole.
4. The shoe lasted and ready for sewing on the welt.
5. The welt partially sewed on.
6. The welt entirely sewed on and the shoe ready for laying the outsole.
7. The outsole.
8. The shoe with the outsole laid and rounded, and the channel lip turned up for stitching.
9. The shoe with the sole stitched on.
10. The shoe with the heel attached.
11. The shoe with the heel trimmed and ready for finishing.

CHART of FACTORY MANAGEMENT



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VI. The Upper Leather Department

In this and the following sections are presented in detail the nature of the departments of shoe manufacture, the actual factory processes in them, and their opportunities for employment for handicapped men.

Nearly all shoe workers are restricted to running particular single machines or doing other work of a single kind. In a few cases, related or consecutive processes may be combined in one process or performed on a single machine. In every case the details of manufacture are of the highest importance, and every operator must observe exactly the specifications of each lot of shoes passing through his hands.

The making of a pair of shoes begins simultaneously in the cutting room of the upper leather division and in the sole leather division of the factory. When an order is received in the order department, records are made of all the specifications for the shoes which are to be made to fill the order. These specifications must be followed throughout the factory, and the shoes when made must conform to them. Tags bearing the number of the order and details regarding the shoe upper are sent to the foreman of the cutting room. Other tags, bearing details about the sole leather to be used, are sent to the foreman of the sole leather room. A third set of tags goes to the foreman of the making room where are brought together the uppers, prepared in the cutting and stitching rooms, and the bottoms, which have been prepared in the sole leather room.

Day sheets, also, are prepared by the dispatch office, showing accurately the details of each lot of shoes passing

into a factory on a given day and the scheduled time when the last lot should pass a given point. These sheets go to the various factory rooms as guides and records of each day's work. The use of the day sheet has greatly promoted efficient methods in the shoe factory.

The Upper Leather Department and Its Divisions. The upper leather department is that division of the factory in which all the parts of the shoe upper, both leather tops, linings, and trimmings, are prepared and assembled for the stitching room. Following are the divisions of the department:

1. Sorting Department
2. Trimming, Cutting, and Dinking Department.
3. Lining and Cloth Cutting Department.
4. Upper Cutting Department.
5. Counting, Marking, and Skiving Department.
6. Assembling Department.

In the sorting department are stored, measured, and sorted the leather and other materials that enter into the top of a shoe. It has three divisions—leather, linings, and trimmings, which are handled separately.

The measuring of upper leather precedes sorting, as the square feet and inches of each piece must be known. The operator takes up a skin, unfolds it, lays it out flat upon the table top of the machine, and causes it to pass into the rollers of the measuring machine, which records the exact number of square inches in it. He must be very careful and trustworthy, able to move about freely in taking up and unfolding the skin, and have the full use of his hands. A man with a slight handicap, who had formerly done this work, might still do it. An inexperienced man with serious handicap of hands, legs, abdomen, or sight could not well become a leather measurer. And as there are only one or two such positions in a factory the opportunity to learn would not be given to any but a most capable person.

A person learns leather measuring by assisting at the machine. The pay ranges from \$25 to \$40 a week. The work offers no particular line of promotion, being in itself permanent for the one who is adapted to it.

The positions in a sorting room are usually as follows:

1. The Inspector.
2. The Head Sorter.
3. Leather and Lining Sorters.
4. Weighers.
5. Men who select the sorted lots of leather according to the cutters' tags.
6. Girls who figure the allowances of leather called for by the tags and keep the cutters' accounts.

The duties of persons in these positions are obvious. The inspector examines the material selected by the sorters to see that it is rightly chosen. He must have intimate knowledge of leather and fabrics and considerable experience himself in sorting. The head sorter directs the work of his assistant sorters, and helps them when necessary. The weighers and the men who put up the jobs called for by the cutters' tags must be careful and accurate, so that leather may be used according to specifications, without material loss in manufacture. They need not be skilled in any other particular line of work.

The Leather Sorter. The cutting room tags call for special kinds of leather for the various lots of shoes that are to be made in a factory. The sorter, who uses these tags in the upper leather room, must be able to judge by experience exactly the quantity and quality of leather required to cut each order. He tests the quality of each skin by doubling it along the back and passing his fingers along the folded edge. When he has selected enough skins for each lot of shoes, he rolls them into a bundle and attaches the proper ticket to indicate their use. He must be

familiar with all the kinds of upper leather used, which are about two hundred at the present time. He must have served several years' apprenticeship as a cutter, so as to learn the kinds, the feel, and the cutting value of leather. Sometimes upper leather is sorted and weighed into lots, so as to be ready for orders from the cutting room.

The Lining Sorter. The various fabrics used in shoe-making, for tops and for linings, must be sorted and inspected according to the weave, strength, and grades for particular uses. The lining sorter, who does this work, has usually had training in a textile school. He rarely learns the work in a shoe factory.

Opportunities for the Handicapped in the Sorting Room. There would be little opportunity for a handicapped person in the sorting room, unless he had had previous experience there. He could not do sorting or inspecting unless he had been a cutter, and he would need at least one good hand and should be able to move about freely. He might, however, test the feel of leather with his thumb and first or second finger if he had lost the other fingers of his right hand. He might sit at a table if some one else could keep him supplied with work, but that is not customary in the factory. Each operator must be able to do all that pertains to his task, that there may be a minimum number of workers employed. Defective sight would be a serious drawback in the sorting room; defective hearing, of slight consequence, as each man has only to follow the cutting room tag.

Weighing and handling lots of leather require considerable moving about, but the work in most cases could be done by a person having one artificial hand and freedom from serious bodily handicap. None of the work of the sorting room calls for great strength, and well-controlled hernia would not incapacitate a man for it. The handi-

capped person might learn to sort linings by attending a textile school.

The earnings of workers in the sorting room run about as follows:

Worker	Beginning or Minimum Pay	Maximum Pay
1. Inspector	\$20.00	\$40.00
2. Head Sorter	20.00	35.00
3. Sorters	15.00	30.00
4. Weighers	12.00	20.00
5. Men Helpers	12.00	18.00
6. Girls	10.00	15.00

There is little opportunity for promotion in the sorting room below the work of the sorter, who may become a head sorter or an inspector.

The sorting room of a modern shoe factory is usually clean, light, well ventilated, and quite free from dust. The work is agreeable and interesting in the great variety of materials handled.

Lining and Cloth Cutting Department. Shoe trimmings may be included with tops and linings. Trimmings are the stays, facings, and other small parts of the upper. The cutting of cloth tops and linings was formerly done by hand. The usual lining parts are, quarter lining, top band, inside stay, fly lining, back stay, and tip. The hand cutter places a pattern upon the cloth and draws a knife quickly around the edge of the pattern. He may thus cut either single thicknesses or layers up to eight thicknesses. Such hand cutting is not accurate and is not rapid enough for present demands. Cutting cloth parts by metal dies is coming increasingly into use. The die is made in the shape of the usual pattern. It is accurate, and many thicknesses of fabric can be cut at one time.

Hand dieing is done by placing the die upon a cloth with the left hand and striking upon it with a heavy hammer or mallet with the right hand. This method, while more rapid than that of hand cutting, is being used less and less. Dinking is the term used for machine dieing. By this method the die is placed upon many thicknesses of fabric on the table of the machine, and pressure by the foot upon a lever brings the heavy top of the machine down upon the die, thus cutting all the thicknesses of the cloth. Machine dieing is used increasingly and solves the difficulty of securing accuracy and speed in cutting cloth tops and linings.

The positions connected with the cutting of cloth tops, linings, and trimmings are usually as follows:

- | | |
|-------------------|----------------------------|
| 1. Foreman | 7. Cloth and Lining Folder |
| 2. Instructor | 8. Piece Sorter |
| 3. Hand Cutter | 9. Inspector |
| 4. Hand Dinker | 10. Cripple Cutter |
| 5. Machine Dinker | 11. Stock Man |
| 6. Pattern Boy | |

The chief work of the department is that of cutting, already described. The pattern boy secures and cares for the patterns; folding and sorting may be done by girls and women. The inspector examines the fabrics used and the work done upon them. The cripple cutter cuts duplicate pieces to take the place of defective parts that may be found in the regularly cut lots. The stock man has charge of all materials in the room. He must know the nature and uses of each and have it ready for cutting at any time. In large factories an instructor is employed to aid the foreman in teaching new employees.

Opportunities for the Handicapped in the Lining and Cloth Cutting Department. In general, the work of cutting in this department requires two good hands and general

health and strength and ability to move about freely. One might, however, do hand cutting and hand dieing if he had an artificial appliance in place of his left hand, or arm and hand, by which he could manipulate the pattern or the die. He would need an uninjured right hand for cutting, or at least a very perfect artificial appliance for wielding the mallet. All methods of cutting could be performed by a person sitting, provided he could reach his materials easily. A person having two hand appliances might do machine dieing, since it consists merely in placing the die in one position after another and working the lever of the machine with the foot, which also might be artificial. The various other duties of this department might be performed by men with various handicaps, but they are mainly the work of girls and women. The inspector or stock man might be a handicapped person, but would need to have had long experience in the work of the department. Inexperienced persons are taken in and trained for most of the work of this department by the foreman or special instructor.

Pay in this section ranges about as follows:

Worker	Beginning or Minimum Pay	Maximum Pay
1. Foreman	\$20.00	\$35.00
2. Hand Cutter	15.00	28.00
3. Hand Dinker	15.00	25.00
4. Machine Dinker	18.00	30.00
5. Folder	10.00	15.00
6. Sorter	10.00	18.00
7. Inspector	15.00	30.00
8. Cripple Cutter	15.00	25.00
9. Stock Man	15.00	25.00
10. Pattern Boy	8.00	12.00
11. Instructor	15.00	30.00

Promotion in this room runs in the usual lines. The hand cutter may become a machine dinker, and both positions may lead to the foremanship. Regularly, however, the fabric cutters may pass on to upper leather cutting after one year or more of service. The fabric sorter may become fabric inspector. The cripple cutter and stock man usually remain permanently in their positions.

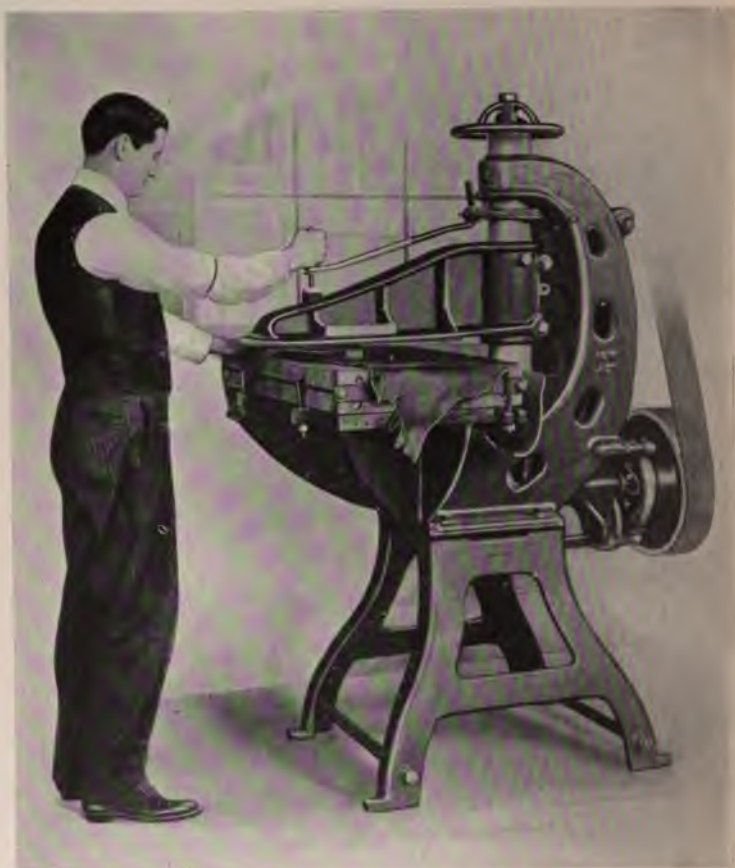
Working conditions here are healthful in a modern factory. In old factories there is often considerable dust from worn wooden floors and from the accumulations of fabric fragments.

The Cutting Room. The most important section of the large upper leather department is the cutting room, in which the leather for the upper parts of the shoe is cut by hand or with a die.

The Hand Cutter. Throughout the long period covering the introduction of machinery into the shoe factory, cutting the upper parts of the shoe by hand has remained in practice. It is still in general use in the smaller and older factories and in factories that handle small skins. It is an expert operation and demands years of practice for the finest work. It is so satisfactory that it gives way but slightly to machine cutting even in the most modern factories. Hand cutting results in the most economical use of leather, as the hand worker is more likely to place his pattern so that the skin may be cut according to the qualities needed for the different parts of the shoe. Hand cutting is done on blocks of wood made especially for the purpose or thick cutting boards arranged at a convenient height for one standing at work. The cutter uses a short-bladed, keen-edged knife. He must know how to keep his block or board smooth and oiled and his knife sharp. He is sometimes called 'outside cutter', to distinguish him from the cutter of linings and trimmings.



A skin showing how patterns are placed in cutting



Operating the Clicking Machine

The cutter is given a roll of leather with its tag from the sorting room and the necessary patterns from the pattern room. He first lays out his patterns conveniently at his left hand in the order of their size, and then unfolds one skin at a time upon the block. He places a particular pattern upon it so that the part selected is best suited to the corresponding part of the completed shoe, and draws his knife point skilfully around the metal edge of the pattern from left to right. This, of course, involves numerous motions and directions of cutting. The patterns are laid alternately and with such variations of size as to make the most economical use of the entire skin. The cutter places all his cut parts in piles and marks the upper piece in each case by pattern, size, width, and style. He ties up these lots with the tag showing and sends them to the assembly room where are sent also the corresponding lining parts. The larger waste parts of cutting are used for trimmings; the smaller are usually sold for use in leather substitutes, or for the oil that may be extracted from them. An exact efficiency record is kept for each cutter, and totals of the work done in the room are placed upon the day sheet.

The Clicking Machine. In the large shoe factories machines for cutting upper leather are coming gradually into use, and hand cutting and machine cutting are found side by side. Late methods of tanning make skins more uniform in quality and the demand for speed is becoming more and more urgent. The machine now in use is called the clicking machine. It has a cutting board or block like that used by the hand worker and has a strong arm or beam that swings from side to side over the block. The operator stands and places a skin upon the block just as the hand worker would do and places a die, instead of pattern, upon the same selected portion of the skin. With his right hand he swings the beam of the machine over

the die, pressing it through the leather by the automatic action of the machine.

Cutting is done upon one thickness of leather only. One movement of the arm of the machine guided by the operator accomplishes in a few seconds what it would take the hand cutter considerable time to do in passing his knife entirely around the edge of the pattern. Machine cutting produces exact sizes, while hand cutting necessarily results in some variations of size. Women are now being employed as hand cutters and produce very satisfactory results. Their quickness of perception and deftness of hand enable them to greatly excel the male cutter. They are not likely to be replaced by men after the war is over.

Opportunities for the Handicapped in the Cutting Room.

A person should have two good hands for hand cutting. The loss of the left hand would make it difficult to place the patterns economically and rapidly. One might use the knife efficiently if he had lost the two smaller fingers of his right hand, but not with greater injury than that. A person having lost one or both legs might cut by sitting at a table, but could not do the work fast enough to earn satisfactory wages, as a definite standard is set in cutting and the operator must be able to work very rapidly. Serious trunk wounds might interfere with a person's speed in cutting and his eyesight must be good. Deafness would not be a handicap. Machine cutting, however, is possible for a person who would be obliged to work sitting, and even to move the dies about on the clicking machine with an appliance for the left hand. The question in this case would be the speed possible for the operator to maintain as he would have to meet the standard of production.

The hand cutter learns the process by working for one year or more in cutting fabrics in the lining and cloth cutting department or by working upon leather in the

cutting room of a small factory. The clicking machine operator is usually a hand cutter transferred to the machine.

The earnings of the hand cutter and of the machine cutter are now \$25 to \$40 a week, while before the war the pay of the cutter varied from \$17 to \$28 or \$30 a week.

There is no promotion in the cutting room or from it to any other room. It is one of the most skilled and desirable operations in the shoe factory. An efficient hand cutter usually remains a hand cutter throughout the years of his employment in the shoe factory.

The cutting room is generally clean and free from dust. It must always be well lighted, and for this reason it is situated on the top floor of the factory with windows in the roof opening to the north to secure an unchanging light throughout the day. The work is agreeable in the handling of leathers of fine qualities and various colors.

The rest of the work of the upper leather department consists of counting, marking, skiving, and assembling. In a large factory they constitute separate rooms. All these duties are performed regularly by girls and women. While they might be done by men with various handicaps, the pay would be small and shoe manufacturers would not change from their present custom of female employment. Here again the quickness and adaptability of the woman outweigh all other considerations.

Skiving is the most important operation after cutting. The edges of the upper leather which are to show in the finished shoe are beveled, or 'skived', so that they may be folded in to give a more finished appearance to the completed shoe. This work is done by girls upon skiving machines. The beveled edges are covered with a coating of leather cement, and placed in a machine which folds and presses them at the same time. Sometimes edges which will show in the finished shoe are scalloped, and

curved edges have little notches cut in them upon the nicking machine. The skiving department includes counting and marking. The usual workers are: Forewoman; floor girls, who give out lots of work to be done, gather them up, and check them off; counters and markers; skivers, nickers, and scallopers; edge stainers, and machinist.

In the assembling room shoe uppers, linings, trimmings, and tips are brought together. These are placed in boxes according to tags, so that each box contains all the parts necessary for a definite lot of complete uppers. Then these assembled parts are divided and sent to the various sections of the stitching room.

CHART of the UPPER LEATHER DEPARTMENT

<i>Upper Leather Department</i>
<i>Sorting Department</i>
<i>Trimming Cutting and Dinking Department</i>
<i>Lining and Cloth Cutting Department</i>
<i>Upper Cutting Department</i>
<i>Counting Marking and Skiving Department</i>
<i>Assembling Department</i>

VII. The Stitching Department

In the stitching department the outer parts of the upper, the linings, and the trimmings are sewed together upon machines, ready for lasting and bottoming. It is sometimes called the 'fitting room'. It is the largest department of the factory, employing over one-fourth of all factory workers. In a factory of 5000 employees about 1400 are in the stitching room.

In earlier times stitching was done chiefly by girls and women. In late years men have taken up the more difficult kinds of machine sewing, such as top stitching and vamping, in which considerable strength is required. At present, about one-third of the operatives of the stitching room are men.

The work of this room deserves special attention on account of its magnitude and many highly skilled processes. The machines used here are similar to the ordinary sewing machine. Because of the many parts entering into the shoe upper, and because of the many styles and kinds of men's, women's, and children's foot-wear, a great number and variety of processes are found in the stitching room. For example, there are forty or more different pieces of material entering into the uppers of an ordinary pair of shoes. All these parts require sewing. The linings and trimmings are given to one division of operators, the outsides to another, and the vamps and tips to another. These parts are all brought together after sewing, inspected, and sent to the lasting room.

The Divisions of the Stitching Department. The divisions determined by the various upper parts to be sewed are as follows:

1. Lining Department.
2. Tip Department.
3. Closing and Staying Department.
4. Foxing Department.
5. Top Stitching Department.
6. Button Fly Department.
7. Vamping Department.
8. Toe Closing Department.

In a factory of considerable size one man acts as a superintendent of this great department, while its eight subdivisions are in charge of forewomen under him. Forewomen are now very generally in charge of rooms in which most of the operatives are girls or women. Sometimes there is a foreman, with an assistant forewoman.

The Lining Department. In this section the various parts of the linings are pasted and sewed together in preparation for sewing to the leather upper in the top stitching department. Each step named constitutes a separate process.

First, the two pieces of lining for each shoe are 'closed', or sewed in a seam, and taped, or stayed, up and down the heel. The top band is then sewed on, the button fly is stitched in, and a lining is stitched upon the tongue for some shoes. Finally, the vamp lining is cemented in place for later sewing.

Aside from the several minor duties, regularly performed by girls, the more important positions in lining stitching are:

- | | |
|-------------------|-------------------|
| 1. Superintendent | 4. Lining Closer |
| 2. Forewoman | 5. Lining Stayer |
| 3. Inspector | 6. Top Band Sewer |

The Tip Department. Tips come from the cutting room tied in bunches separate from the rest of the shoe. In the tip department they are skived, perforated for adornment,

and fitted with linings. A toe box which gives reinforcement and shape is inserted and cemented. The tip may be skived and folded in, perforated, nicked, scalloped, or plain. The lining is cemented in, taped over seams, and pressed firmly in place upon a machine. The whole is top-stitched on a machine, through leather and lining, just below the line of perforation. Then the tip is stitched above the perforation to the vamp of the upper, ready to go to the vamping department.

The positions in the tip department include the operations enumerated in the preceding paragraph and some small related processes.

The Closing and Staying Department. This department cements, sews, and secures the seams of the top part of the shoe upper, following the work done in the lining room and tip room. The button fly is pressed, closed, or sewed, upon one quarter, and the two quarters of the top are sewed together. There are numerous operations, of the same general nature, in this room of a shoe factory, which depend upon the kind or style of shoe being made. Special machines are in use for special kinds of shoes. The Oxford shoe and the Polish shoe, for instance, call for different sets of operations.

The usual positions in closing and staying are as follows:

- | | |
|---------------------------------------|--------------------------|
| 1. Forewoman, or assistant to foreman | 6. Button Fly Presser |
| 2. Inspector | 7. Button Fly Reinforcer |
| 3. Instructor | 8. Stayer |
| 4. Closer | 9. Toe Piece Reinforcer |
| 5. Label Girl and Cementer | 10. Cementer and Presser |

The Foxing Department. This is one of the smallest divisions of the stitching room. The 'foxing' is a little piece of plain or ornamental upper leather sewed below the quarters, or main parts of the tops above the vamp.

The Polish shoe and the Oxford, however, have a long vamp and no foxing. Back straps and fly stays are stitched upon the quarters to which the foxing is to be attached, and then this is sewed on with one or two rows of stitching.

The chief positions in the foxing room include the forewoman, instructor, inspector and stitchers.

The Top Stitching Department. This is the division of the stitching room in which the tops of the leather uppers bearing the foxing, when that is attached, and the linings, coming from the lining department, are sewed together. First, the quarters and linings are matched upon tables and tied together in bundles, according to tag numbers, by floor girls, who take the bundles to the machine operators. Processes vary according to kinds and styles of shoes. The four leading processes in this division are among the most important in shoe manufacture. While once they were performed by women, men are now found in them in increasing numbers. These processes demand judgment, carefulness, and considerable strength as well as quickness. The four processes are as follows:

1. Top Closing, in which the quarters and lining are put back to back, wrong side out, and sewed along the edge of the top.
2. Pounding out Seam, in which the closed top and lining are turned right side out by hand and pounded flat and true on the outside.
3. Top Stitching, in which the turned top and lining are stitched all around except at the bottom where the vamp is to be attached.
4. Vamping, sewing the vamp to the closed, smoothed, and stitched upper. Vamping is usually done in the vamping room; it may, however, be done in the top stitching room. This is usually the case in making canvas shoes.

The leading positions in the department are as follows:

- | | |
|-----------------------------------|-------------------------|
| 1. Forewoman | 5. Operator for turning |
| 2. Instructor | and pounding top |
| 3. Inspector | 6. Top Stitcher |
| 4. Operator of closing-on machine | 7. Vamper |

The Button Hole Department. The making of button holes on button shoes and the inserting of eyelets in lace shoes, small as these processes may appear in shoemaking, constitute a separate department. The button hole is inserted on a power machine, which cuts the hole and works it around at the same time. In eyeleting, the upper is first marked by hand, and then the eyelet is inserted on a machine. On men's high lace shoes hooks are inserted above the eyelets, by a similar machine. The department has a forewoman, instructor, inspector, operators for the button-hole machine and eyeleting machine, and for other small related processes. It is essentially a woman's section in the factory.

The Vamping Department. The vamp is the lower, front part of the shoe. A whole vamp extends from toe to heel, with a seam at the heel only. The more common is the 'cut off vamp', which extends forward only to the tip. The vamp is the part of the upper on which the greatest strain and wear come, and is regularly cut from the best leather. Canvas shoes are usually vamped in the top stitching room. This work on leather shoes requires a separate section. Vamping consists in sewing the vamp to the quarters of the top, each style of shoe calling for a particular process.

Vamping is the most painstaking work of the stitching room. Even now, three-fourths of the operators on this process are men.

The few positions in this work are: Foreman, instructor, inspector, and vamper.

The Toe Closing Department. This is the final division of the work in the stitching room. Tops and linings have been sewed together, and vamps have been sewed to the tops, when a job of work reaches this room. Here the toe lining is smoothed out and double-stitched. The process is called closing.

Machine operators in the stitching room generally learn by working upon linings, on cheaper leather parts, or on low-grade work in any factory. In all divisions the forewoman and her instructor teach new operators by giving individual attention. So important is it to have competent workers in the department that new girls, women, or men are constantly sought and given training on special operations. Many workers are trained in several kinds of stitching, so that a scarcity of operators at any time on any set of machines may be met by transferring operators from other machines.

The running of a power sewing machine calls for considerable training and skill, and for at least fair health and strength. On all machines the start is made by pressing the toe on the treadle, and the stop by pressing with the heel.

Some automatic machines produce in operators a nervous, spasmodic action. This is especially noticeable in running the barring machine and other machines having an eccentric movement. In such cases, operators are usually transferred in time to different or less injurious machines or processes.

Opportunities for the Handicapped in the Stitching Department. This is the division of the shoe factory in which there seems to be the largest number of opportunities for handicapped persons to work. All machine operations are performed sitting. But in general one must have good eyesight, two good hands to direct work in the machine, and one good leg to start and stop the machine. Yet a

person with one natural hand, and an appliance for the other, might do sewing on some of the minor processes, in which the part could be guided mainly by one hand. A person having only the thumb and first or second finger of either hand might perform some of the processes of stitching, if he could handle and guide materials accurately in the machine. And if a man had lost both legs a mechanical appliance for the leg or foot might be so perfect and sensitive to position and motion as to enable an operator to start and stop a sewing machine at will. Head, neck, or trunk injuries which did not prevent a free movement of the arms and shoulders when seated at the machine would not seriously incapacitate a worker. Serious hernia or bodily injuries would incapacitate one. A person suffering seriously from nervous shock could not work at a power sewing machine.

The following division indicates the more difficult and less difficult processes of the stitching room from the standpoint of work with the hands. Most of the minor operations, regularly performed by girls, are omitted.

A. Processes demanding a worker with two good hands:

1. Lining Closing and Staying
2. Tip Skiving and Lining
3. Cementing Tip Lining
4. Inserting Toe Box
5. Tip Stitching
6. Top Closing and Staying
7. Pounding the Seam in Top Closing
8. Top Stitching
9. Button Hole Making
10. Vamping

B. Processes which might be performed with one good hand and a mechanical appliance for the other:

1. Cementing vamp lining
2. Tip Perforating or Nicking
3. Button Fly, Pressing, Closing, and Staying
4. Stitching Back Straps, Loops, and Buckle Straps
5. Foxing Stitching
6. Inserting Eyelets and Lace Hooks
7. Toe Closing

The so-called 'table work' of the stitching room, such as counting and matching leather and lining parts of uppers, could be done by handicapped persons, but would pay low wages, from \$10 to \$15 a week.

Pay in the stitching room runs about as follows:

Operation	Beginning or Minimum Pay	Maximum Pay
Table Work	\$10.00	\$15.00
Minor Operations	12.00	18.00
Backstay Stitching	16.00	20.00
Buttonhole Making	16.00	20.00
Closing-on	25.00	30.00
Foxing	16.00	20.00
Tip Stitching	18.00	25.00
Top Stitching	20.00	30.00
Vamping	25.00	45.00

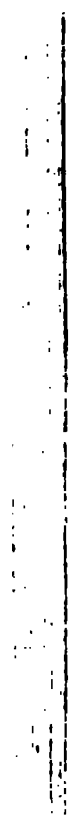
Promotion is common in the stitching department of a shoe factory, from table work to minor machine processes, and from minor to major machine processes. The one or several chief operations in each room of the department are the most desirable and best paying, while closing-on, top stitching, and vamping stand out as the best of all work in the department.

In old factory buildings, in the older shoe manufacturing centers, the stitching room is often poorly lighted and dusty. The newer factories have larger window spaces, so that even the middle portions of the room are light and

cause no eye strain. They have better floors, also, and have them swept up twice a day, during the lunch hour and at night. There is a great deal of noise from the constant running of the many power machines of the average factory, and the close attention necessary for accurate and rapid work is wearing upon the operator. Sitting at the machine and the constant bending of the head and shoulders over one's work are, of course, injurious if kept up for years.

CHART of the STITCHING DEPARTMENT

<i>Stitching Department</i>
<i>Lining Department</i>
<i>Tip Department</i>
<i>Closing and Staying Department</i>
<i>Foxing Department</i>
<i>Top Stitching Department</i>
<i>Button Hole Department</i>
<i>Vamping Department</i>
<i>Toe Closing Department</i>



VIII. The Sole Leather Department

The sole leather division of the shoe factory deals with the preparation of the bottom parts of the shoe. It is often called the bottom stock fitting department. Its subdivisions prepare the following parts:

1. Inner Soles
2. Outer Soles
3. Counters
4. Toe Boxes
5. Heels

These sole leather parts may all be prepared, in the rough, in special factories, and sold to the ordinary shoe factory in quantity, or the large shoe factory may itself make them all. In either case the work done upon the parts is the same. McKay shoes and Goodyear welt each call for some special processes, and the increasing use of leather substitutes for insoles modifies the work done.

The Inner Sole Department. The use of poorer parts of the hide, or substitutes, for the inner sole, the use of canvas in reinforcement, and the necessity of preparing this sole for the attachment of both top and outer sole, make the inner sole department the most important in bottom stock fitting.

Light sole leather is generally used for the McKay inner sole. It is dipped in a solution of glue to stiffen it, dried, and cut out by a die upon a machine. The chief process here is that upon the dinking machine.

Welt inner soles are made of leather of good quality or are reinforced by canvas cemented upon it. The soles are dinked out and sometimes passed through a heavy rolling machine to wet and press the fibers of the leather closely together, to increase its strength for holding stitches. A channel is cut around the sole on its under

side and the welt is sewed to this. The canvas reinforced insole is treated in much the same way as the other, except that it is not rolled. It is characterized by lightness and strength.

The most important workers in this division are:

- | | |
|---------------------------|------------------------|
| 1. Foreman | 6. Channeler |
| 2. Assistant Foreman | 7. Wetter and Cementer |
| 3. Inspector | 8. Rander |
| 4. Dinker and Stamper | 9. Canvas Cutter |
| 5. Heel Marker and Cutter | 10. Canvas Attacher |

There are several related processes, done usually by girls.

The main processes in the treatment of outer soles are similar to those given inner soles. The outer sole is first blocked or dinked out in the rough, and then 'rounded' into approximate shape for attaching to the shoe top and inner sole.

The Counter Department. The counter is a stiffening material in the back of the shoe between the leather and the lining, around the heel of the foot. Its purpose is to keep the heel from 'running over' at the side. It is made of sole leather or of numerous substitutes. It is cut out with a die, its upper edge skived thin, and then it is wet and molded into shape. Each of these processes is short and simple. A considerable number of boys and girls is usually employed in this department.

The toe box is a reinforcement placed in the toe of a shoe, similar to the counter at the heel but meant to give distinctive style to a shoe. The processes in making toe boxes are the same as in counter making.

The Heel Department. Heels are usually made of the poorer parts of sole leather, including the remnants from soles, counters, and toe boxes, leather board, other sub-

stitutes, and wood. The small pieces used for the heel are usually skived to even thickness and rolled to make them hard and firm. Then they are cut into various heel lift sizes upon the dinking machine, with due care in getting the most out of each piece. In 'heel building' the worker places one lift upon another, by graded sizes, up to the desired height. This pile is pasted or glued and a nail is driven through it by a machine to hold it firmly together until it is attached to the shoe in the bottoming room. The heel is then compressed in a machine, and its front or breast is later cut off smoothly before attaching. A top lift of superior leather is added in the bottoming room.

The processes of heel making are simple and easy, and mostly performed by boys, girls, or women. Heel building is somewhat more difficult. It calls for judgment, speed, and some strength.

The heavier process in the sole leather department and the larger machines require men as operators, but the many lighter processes and the handling of small parts make possible the employment of large numbers of boys and girls and women. In the average factory this department usually has about an even division of male and female employees, standing next to the stitching room in its proportion of the latter.

Opportunities for the Handicapped in the Sole Leather Department. Men who would be obliged to sit at their work through loss of one or both legs could do table work and bench processes in the sole leather room. They could operate the dinking and rolling machines, by sitting and being able to work the levers. Injuries to head or trunk, including controlled hernia, would not incapacitate a worker in this room, if he could keep up to speed. Channeling and heel building would require two good hands and ability to move about freely. The operations on the counter and toe box could be performed by a person who had

lost several fingers of either hand or had a mechanical appliance for his left hand.

The machine processes in the sole leather room are taught to beginners by the foreman or his assistant. Most of these processes are simple and easily learned in a few days or a few weeks. Any worker may be taught several processes.

Pay for the minor operations of the department ranges from \$10 to \$15 a week; for the work of ordinary difficulty, from \$12 to \$20; and channelers, machine dinkers, and heel builders earn from \$18 to \$30.

A person may be promoted from bench work to a minor process, and from a minor to a major process.

Work conditions in this department are less favorable than in the upper leather department or stitching room. The use of large quantities of gum, glue, and water in the treatment of sole leather produces considerable dampness, and the extensive use of leather fragments and cheap substitutes causes accumulations of dust. The modern factory minimizes these dangers by constant cleaning of floors, tables, and machinery. There is no especial danger from machinery in the room.

IX. The Making Department

This department embraces the heaviest and most exacting work of shoe manufacture. The major operations are regularly performed by men, who must be strong and active. Boys, girls, and women, usually about one-fourth of the operatives of the room, assist by doing the lesser processes and by handling materials. The machines used are always placed along the sides of the room, next to the windows, to secure good light for the many intricate operations necessary.

The department is called also the bottoming department and the 'gang' room. In the earlier factories the work of the room was done mainly by gangs of men, and these are still found in some factories.

In the making department the uppers of shoes, prepared in the upper leather room and stitching room, and the soles, prepared in the sole leather room, are brought together, lasted, and made into shoes ready for finishing.

The department has the following divisions:

1. The Lasting Department
2. The Welt Bottoming Department
3. The McKay Bottoming Department
4. The Heeling Department
5. The Turned Shoe Department
6. The Standard Screw, Nailed, or Pegged Department

These divisions are not clearly drawn, and through them all runs one general method of bottoming which is modified only by the kinds and styles of shoes manufactured.

The Lasting Department. Here begins the work of bottoming the shoe. Lasting consists in drawing the shoe

upper, both leather and lining parts, over the top of the last and inner sole, so that the outer sole may then be attached. Shoes are lasted both by hand and by machinery. The processes involved demand carefulness and strength. The box toe is put in its proper place between upper and lining, and the counter in its place at the heel. The inner sole is tacked upon the bottom of the last. Then, by hand or on the lasting machine, the full upper is drawn over the last and inner sole and tacked in place temporarily. Then the shoe is placed upon the pulling-over machine, which has pincers that act like the fingers of the hand, grasping the leather and drawing it in and over evenly around the last. By an adjustment of levers, drawing in and tacking the parts down are done automatically. The surplus leather pulled over the bottom at the toe and heel is removed upon the upper trimming machine in which a knife cuts the extra parts evenly away. Upon another machine the leather and counter around the heel are beaten or pounded down to the shape of the last. Then the shoe is ready for the outer sole.

The four important processes in lasting are operating the lasting machine, the pulling-over machine, the trimming machine, and the pounding machine.

The Welt Bottoming Department. The welt method of attaching the outer sole is coming increasingly into use, since it produces a smooth bottom inside the shoe, and greater flexibility and ease in repairing. The welt is a narrow strip of leather so prepared that it may be sewed first to the lip of the inner sole and to the upper leather, and then to the outer sole. Thus these three parts are joined firmly together, with no stitching passing entirely through the bottom of the shoe as in the McKay method. It is claimed that this particular improvement has been the leading factor in the great development of shoemaking in recent years.







McKAY AUTOMATIC
HEEL LOADING AND
ATTACHING MACHINE

The welt is beaten down smoothly, and the bottom of the insole and welt is covered with a coating of cement. At the same time the outsole which is to be attached is coated with cement. Within a few minutes, when the cement has partially dried, the outsole is put in place and pressed firmly in the sole laying machine, remaining long enough for the cement to hold firmly. Then follows one of the most arduous processes of the factory, 'rough rounding'. This consists in trimming the sole and welt, now cemented together, so that they will extend a uniform distance out from the upper leather. The operator holds the shoe up firmly against the cutter of the rough rounding machine, turning the shoe a nearly complete revolution, and trimming it entirely around in front of the heel seat. The machine gauges the distance of cutting from the last, and cuts a little channel in the bottom for concealing the stitching which is yet to be done. The sole is trimmed at the heel on the heel seat rounding machine, and nailed to the inner sole.

The outsole is now stitched to the welt entirely around the shoe upon the lockstitch machine. The lip of the channel is cemented and pressed down smoothly over this stitching in the channel laying machine. Then the shoe is put beneath the roller of the automatic sole leveling machine, which removes every unevenness.

From this point on the blacking, burnishing, and finishing processes take place. The edge of the shoe is burnished on the edge setting machine, being held against two rapidly vibrating hot irons. The other processes may be done in the bottoming department or in a separate finishing department. The bottom of the shoe is buffed upon revolving rollers covered with sand paper, to remove the marks of handling in various operations, and to a finer degree in several processes to give polish. The treatment

of other finishing processes is given in a later section of this Bulletin.

The list of workers in the welt bottoming department is a long one. It is usually about as follows:

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|-----------------------|-------------------|
| 1. The Superintendent | 19. Channel Laver |
| 2. Foreman | 20. Wheeler |
| 3. Assistant Foreman | 21. Rander |
| 4. Tack Puller | 22. Leveler |
| 5. Welter | 23. Heeler |
| 6. Inseam Trimmer | 24. Slugger |
| 7. Welt Scarfer | 25. Heel Shaver |
| 8. Welt Beater | 26. Heel Breaster |
| 9. Shank Nailer | 27. Edge Trimmer |
| 10. Bottom Filler | 28. Heel Scourer |
| 11. Welt Cementer | 29. Heel Jointer |
| 12. Sole Cementer | 30. Edge Setter |
| 13. Sole Layer | 31. Burnisher |
| 14. Heel Seat Nailer | 32. Blacker |
| 15. Rough Rounder | 33. Buffer |
| 16. Channel Opener | 34. Hard Finisher |
| 17. Goodyear Stitcher | 35. Polisher |
| 18. Channel Cementer | |

The McKay Bottoming Department. In McKay bottoming the upper is attached to the sole by a machine which sews directly through the outsole, upper leather and lining, and insole. The work is done in a separate room where the lasted upper comes from the lasting room. The outsole comes from the sole leather department, where it has been kept moist for use. First, the surplus leather and nails of the upper on the last are ground off on an abrasive wheel, so that the outsole will lie flat when put on. This sole is put in place and tacked upon another machine. The last is then withdrawn by hand, and stitching is performed upon the McKay stitching machine. The process is a heavy, exacting one, and is still used very widely, in spite of the superiority of the welt method. Other work on the

McKay shoe is so nearly similar to that on the welt shoe that it need not be detailed here. Before relasting McKays a bottom lining, or second thin inner sole, is inserted.

The Heeling Department. The heel is attached upon the heeling machine. The shoe is placed upside down on a jack in the machine, the heel, already built up, is set in place, and an arm bearing the nails is swung automatically over the heel, driving the nails through heel, outsole, upper leather, and insole, where they are clinched on the inside. The action of this machine is like that of the clicking machine in the upper leather cutting room, though it is more powerful and heavier to run. A top lift is added to the heel, covering the nails inserted by the machine, and slugs are driven into it.

The heel is now trimmed on the heel trimmer, which by means of a rapidly revolving knife cuts away all the surplus leather on the outside. This process is a very exacting one, calling for strength and skill. Like the movement of rough rounding the sole, the heel must be turned in a circle from one corner to the other. It is more injurious to the wrist of the operator than is sole trimming, as greater pressure must be exerted to cut off the surplus leather of the thick heel, and the wrist is twisted as well as turned. It sometimes produces what is called 'broken wrist', or a weak wrist. In this case the operator is transferred to some other, lighter process.

The three processes in this room are nailing on heels, slugging, and trimming.

The Turned Shoe Department. Some light shoes and slippers have always been made wrong side out and then turned right side out. This is possible only when thin, flexible sole leather is used. This method produces footwear of indoor comfort rather than of wearing qualities.

The Standard Screw, Pegged, or Nailed Department. Various kinds of heavy working boots and shoes are

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al appliance for the left, provided he could keep up degree of speed. The loss of one eye would not re with the work, and deafness would not incapacitate. Head or bodily injuries that would interfere movement would be handicaps. A person suffering from shell shock would not be suited to work in the making room.

various processes of the making room are still done by working at a machine or bench, with instruction by the foreman, his assistant, a special room instructor, or an expert workman. Those who wish to become operators are more often given a chance to learn in a small shop or in a less busy time in a large factory. A person of average intelligence and ability should become able to run any bottoming machine in three months. Not only must the hand and eye be trained, but a new set of muscles must be developed in action. Frequently, of course, a person learns to run more than one machine. The following are the leading operations in the making room of a factory ranges about as follows:

Process	Beginning or Minimum Pay	Maximum Pay
Setting	\$15.00	\$25.00
Trimming	20.00	35.00
ear Stitching	20.00	35.00
ear Welting	22.00	40.00
reasting	15.00	25.00
urnishing	15.00	25.00
g.	20.00	40.00
couring	15.00	25.00
rimming	20.00	40.00
g, Various Processes	15.00	35.00
y Sewing	18.00	35.00
Rounding	20.00	40.00

The above represent no absolute minimum and maximum earnings in the industry. Factories of different size and in different localities pay varying wages. The first column of figures might be taken as the average rates in small country factories; and the second column, as the rates paid in large shoe centers. Operations not included in the list pay lower wages, or living wages for a man—from \$10 to \$18 or \$20 a week.

There is no regular line of promotion in this department. The operators of the more important machines do the same work for years. A person doing a minor process may be allowed to learn a major one if he has the requisite strength and ability, as it is not always easy for the factories to secure capable operators for the more difficult machines.

The chief objection to working in the making room is the incessant noise of the large number of heavy, automatic power machines necessary in this room in any factory of size. Stitching on the various parts of the shoe bottom, always at a rapid speed, is taxing upon the eyes. And the glare of the burning jets of the edge setting machine, always near the eyes of the operator, is blinding. The effects of work on the sole and heel trimming machines have already been spoken of. There is danger of injury to the hands or fingers from the tacks used in lasting, from the wire and nails used in low grade shoes, and less frequently from the heavy needles used in the sole sewing machines. There is usually considerable dust in this room. The abrasive machines are, of course, covered with hoods which minimize this danger.

X. Finishing and Treeing

In a large shoe factory the magnitude of manufacture necessitates separate departments for finishing and treeing. The special part of finishing that is of greatest interest is tip repairing. In the passage through the factory the vamp, the linings, the toe box, and the tip have been brought together in the completed toe of the shoe. In lasting and working upon so many thicknesses, especially with the patent leather tip now so generally in use, the shoe comes to the finishing room in most cases with the tip scratched or otherwise injured. Slight injuries are repaired by rubbing down by hand or by machine brushes. In case of a serious injury the old enamel or varnished surface is sandpapered entirely off, and a new coat of varnish is applied by hand. Tip repairing has been essentially hand work, and is usually done by women. Some factories now use a tip repairing machine. The process demands minute inspection, patient application to repairing an injury, deftness of touch, and good judgment.

Treeing is the work done in making a shoe conform perfectly to the shape of the last and of restoring the original finish of the leather, after the passage of the shoe through many hands. The last is drawn out, tacks or inside imperfections are removed, and bottom linings or heel pads are inserted. The shoe is then placed upon one of the tree arms. Dirt or other materials that may have adhered to the surface in making are removed by a brush or by washing with a cleaner. An oil dressing is applied to fill the pores of the leather. In some cases the leather is restrained. When the surface of the leather has

been fully restored the shoe is ironed upon the tree to give it perfect and permanent form. Ironing consists in rubbing the surface of the shoe, by hand, with a warm or hot iron, to smooth and shrink it to shape. The process is a very important one, requiring great care and some strength. It is performed regularly by men.

Opportunities for the Handicapped in Finishing and Treeing. The work of both finishing and treeing may be done by persons seated. Two good hands would be necessary in treeing. Finishing might be performed with one natural hand and an effective artificial appliance. Good eyesight would be needed in each process. Bodily injury that would hinder one's free movement on a seat would incapacitate a person.

The processes are learned by work upon them, under instruction, in a small factory or in the department in a large factory. The 'treeing man' ought generally to be familiar with the nature and tanning of leather and with shoemaking processes, to correct defects in material or in manufacture.

In the case of men there may be promotion from finishing to treeing. Working conditions in the finishing and treeing rooms are not objectionable. There is some slight dust from polishing machines, but hoods draw most of it away. There is some dust from the hand use of sand paper in tip repairing. The use of leather stains, oils, and polishing materials results in no special injury. On the other hand, working upon various colors and kinds of highly polished leather makes the several processes enjoyable and attractive to most operators.



Shop of the Philadelphia Shoe Repairing Company

XI. The Shoe Repairing Industry

The individual shoe cobbler is still found in almost every community, but in recent years repairing has become a special branch of the great shoe industry. It is now a shop industry in itself. There are approximately 50,000 shoe repair shops in this country, with an annual business of fully \$300,000,000. These range from the shop in which one man does handwork to the shops conducted by retail stores and the large independent shops which have machinery and employ a considerable number of workers. Probably nearly 20,000 of these larger shops are fitted out with modern shoe machinery. Such machinery is manufactured especially for repair work and is simplified since it must sometimes be operated by unskilled workers or by workers who have not had experience in the shoe factory. Usually the machines are all set on one motor-drive shaft along one side of the shop, and comprise the lockstitch sole sewing machine, the leveler, trimmer, edge setter, and burnishing and polishing brushes. A shop may have several sets of machines on each of which a team of men usually works. Such a shop may employ from twenty-five to thirty-five men and may repair from 60,000 to 70,000 pairs of shoes a year. A few shops employ as many as sixty or seventy men. A tag system is used resembling that of a regular factory. In a small shop each worker may be capable of doing all the repair processes. In the large shop the work is subdivided. As many as seven men, each doing a particular process, may work at the same time on the machines of the shaft.

Some such concerns call for shoes at the homes of customers and return them after making the necessary

~~repairs.~~ In many of the shops a shoe shining department is maintained, and nearly all of them sell shoe supplies. In some western communities steam laundries have established shoe repair departments, since their wagons can collect shoes upon their regular laundry trips.

There are now over eighty local organizations of shoe repairers in the United States, and the increasing cost of leather and footwear during the war has given a great impetus to the industry. An investigation into machine shoe repairing throughout the country has recently been made by Mr. Frank W. Whitcher of Boston, some of the results of which may be summarized as follows: ¹

1. Machine shoe repairing has supplanted hand repairing to the extent of eighty per cent. in the Middle States and Northwest, fifty per cent. in the Far West, seventy-five per cent in the South, and ninety per cent. in the East.

2. The Number of men employed varies from the boss and from one to three or four men in shops having a single machine repair outfit to the city shop having several outfits and using from thirty-five to forty men.

3. The average shop repairs from twenty-five to forty pairs of shoes per day, or ten to twelve pairs for each man working.

4. The business of the average shop amounts to \$1 on each pair of shoes repaired, being from \$25 to \$40 a day or from \$6,000 to \$12,000 a year.

5. The yearly percentage of increase in repairing since the outbreak of the war has been from fifteen to forty per cent. in the Middle States and Northwest, fifty per cent. in the West and South, and from twenty-five to forty per cent. in the East.

The hand shoe repairer may easily learn machine shoe repairing. He may secure an equipment of machinery, hire helpers if necessary, and open a repair shop. Men of mechanical ability may be taken into the repair shop

¹ See article on '\$300,000,000 Spent for Shoe Repairs' in *The Shoe Repairer and Dealer* for August, 1917.

to learn both hand processes and machine operations. From these machine operations they may pass directly into corresponding work in the shoe factory. Less frequently, workers in the factory leave and open shops of their own.

Steps are being taken in several places to provide special training in shoe repairing, for returned soldiers and others, because of the recent scarcity of men for the repair shops. Plans are not yet formulated and the early closing of the war may delay them, but it may be stated that a well-known shoe machinery repairing company has contemplated turning one of its local shops into a repairing school to be conducted under Government or other auspices for the benefit of the entire industry.

In the small shop, employing few workers, and doing mostly hand repairing, the earnings may vary from two to five dollars or more a day. In the large shop, in which repair work is done mainly by machinery, the operator earns about the same as he would in the same processes in the shoe factory. Employment in repairing is fairly steady through the year in most communities, but it is somewhat reduced in the large town or city during the summer season.

Opportunities for Handicapped Men in Shoe Repairing. Disabled men may become individual shoe repairers even if having only one good hand and an efficient appliance for the other. Hand repairing is regularly done seated. At present machine repairing is done standing, but seats might easily be arranged at the machines as may be done in the shoe factory for women and disabled men. The handicapped man will not meet the difficulty of factory speed in the shoe repair shop, except at times in team work, so that he may enter it even if he is not capable of making a large daily output. One or more men who have physical handicaps and who are familiar with shoe work,

or who may learn it in their industrial reeducation, in successfully open a machine shoe repair shop in community. Repairing machinery may be leased or chased outright at comparatively low cost.

The Trade Promotion Bureau of the National Leather and Shoe Finders' Association, at St. Louis, has recently taken up the matter of the advancement of the shoe repairing industry. A letter from Mr. George A. Knapp, Secretary-Director of the Bureau, to the writer is here reproduced:

I have your esteemed favor of November 8, and I want to thank yourself and Mr. Whitcher for giving me this opportunity of briefly laying before you the work which the Trade Promotion Bureau, of which I am Director, has undertaken. This Trade Promotion Bureau is supported by the members of the National Leather & Shoe Finders' Assn., which is composed of manufacturers, tanners and jobbers, who supply the materials used by the shoe repairers throughout the United States. We have felt for a long time that the shoe repairing service which the public has been receiving is not of the proper caliber. We are convinced that shoe repairing is just as important to the public as other repair service, because if it is properly done it doubles the life of a shoe, and is, from this standpoint, of great economy to the public. Therefore our Trade Promotion Bureau has, for the past nine months, been carrying on a propaganda that has for its ultimate object the advancement of the shoe repairing industry. We have been striving during this time to impress upon the shoe repairers that good workmanship and good materials insure a quality job of shoe repairing and we have been trying to convince them that if they will give this kind of shoe repairing service to the public they will advance their interests and make shoe repairing a more popular service than it is today. We have also tried to get the shoe repairer to improve his business policies by introducing salesmanship, by making his shoe repair shop a supply depot, by keeping an acc-

of his business and by advertising the service that he can render, in his neighborhood. In order to bring these suggestions to the shoe repairer in concrete form we have gotten up some advertising suggestions and we have sold over 200,000 of these to the shoe repairers at cost. We have also prepared an account book which we sell to the shoe repairer at 50 cents. This book is large enough to take care of two years' business, and hence costs the shoe repairer but two cents a month. We have issued several pamphlets and written a number of letters to the shoe repairer, urging these improvements in his business. At the present time I am preparing a pamphlet that will show the interested shoe repairer just how important his service is to the public and that it should take its place in line with other neighborhood service.

I also wish to state that at the present time we are trying to interest the Trade and Manual Training Schools throughout the United States in adding shoe repairing courses so that the pupils in these schools may be taught the art of shoe repairing. We have done little along this line as yet, as I have been unable to obtain a list of these Trade Schools, but I now have assurance from the Government that they will furnish me a list of these schools and as soon as I get this list I will take this matter up with each of these schools direct.

We know for a fact that shoe repairing is an honorable occupation and that it may be made a very remunerative one, and we believe that the time has come when shoe repairing will soon take its stand alongside of such service as the laundries, the clothes pressers, and other services which cater to the general public.

Crippled men can do this work just as well as men who have all their limbs. I believe that a man with one hand can do just as good shoe repairing as a man with two, and the loss of his lower limbs would not affect his efficiency at all. Of course, one would have to have good eyesight, as we are now using power machinery in shoe repairing and it would be dangerous to permit blind people to enter the industry.



XII. Training Employees in the Shoe Industry

Shoemaking is a trade, with many specialized divisions. Some of these divisions, such as the simpler operations in the various rooms, are distinctly unskilled operations; others, like cutting, welting, and trimming edges, are highly skilled trades. The first kind calls for a very brief period of learning, sometimes a few days only; the other division includes processes requiring in many cases several months or even years for learning. The operator may learn several related processes, but in the large factory he remains essentially a worker or an expert in one.

In this country, as has been indicated in the preceding pages, the shoe operator as a rule learns his trade by actual work on factory processes. In a small shoe establishment, and quite regularly in a country town, inexperienced persons may be taken in to learn most processes. Persons thus learning branches of shoe manufacture quite often enter the large factories as experienced operators. In the large factories, especially in the great shoe centers, inexperienced persons are taken in only for the minor processes, and more often in the stitching than in other departments. There is quite a steady movement of the more highly skilled shoe operatives from factory to factory, and from one shoe center to another.

In European countries, on the other hand, there are numerous publicly maintained schools of shoemaking, in which one may learn 'cobbling', hand shoemaking, and factory operations. In America the industry is almost entirely one of machine work. Hand work has been

reduced to a minimum. Even repairing is becoming more and more a set of machine processes. Our shoe factories have not yet established anything like the vestibule schools now being opened in some other industries, since the training of shoe workers has not yet been a serious problem, like that of the securing of a sufficient number of workers of fair intelligence and ability to enter the industry in war times. Superintendents, foremen, and special instructors, however, in a few factories train employees in small groups in the work of their departments.

In several large shoe centers private schools for shoe workers have been established. The work upon which operators learn usually consists of low grade shoes made by the school for factories, on a contract basis, or upon shoes manufactured from materials of second quality, bought at a low price from supply factories or from shoe factories. Persons wishing to learn a process of shoe-making are taken on rather as helpers at first in that process, giving their time and paying a fixed tuition, such as thirty or sixty or eighty dollars, without special regard to the time required for learning. The time spent in learning, however, may run from one to seven or eight months. Operators run the same machines, though sometimes second hand, as are used in the shoe factory, and generally become capable of entering factories as fairly efficient workers.

A few towns and cities, in cooperation with shoe and leather manufactures, have established courses in shoe and leather subjects in the continuation school or the public school system. These courses, however, are mainly attended by persons already working in factories and leather houses and seeking additional training to increase their efficiency and earning capacity.

The instructors are superintendents and experts in the trade who have been given special training for teaching. The establishment of such courses marks a great advance in the shoe and leather industries. Following is a statement on the Shoe and Leather Course of the Boston Continuation School, prepared by Mr. Owen D. Evans, Principal of the school:

In 1916 with the cooperation of the New England Shoe and Leather Association the Boston Continuation School started a voluntary short unit course on the shoe and leather industry. Since that time the course has been given once or twice each winter. To date a total of over 300 men in the shoe and leather industry have successfully completed the work. The men who take the course range from eighteen to twenty-five years of age; most of them are high school or college graduates. Their work lies on the distributing side of the industry rather than in production. The sessions are two hours each, twice a week during working hours for twelve weeks. A small tuition fee is charged for persons not residents of Boston. Usually the employer pays the tuition fee. The work consists of lectures, demonstrations, class discussions, varied by frequent trips of investigation and inspection to tanneries, stock rooms and factories.

The detail of the typical twelve weeks' course is indicated by the following schedule for 1918, in which lectures are given by the instructor unless otherwise specified:

1. Brief historical account of leather making. Trade centers in the United States. Sources of hides and skins. Methods of curing.
2. Classification of hides and skins according to age, source, injuries, and 'take-off'.
3. Discussion of hide reports in trade papers to bring out above points. Merchandising of hides and skins. Chemical and anatomical structure of skin as applied to unhairing, fleshing, and liming.
4. Trip to New England Dressed Meat and Wool Co., Somerville. Killing of cattle and sheep. Care of hides in hide basement. Scouring and painting of sheepskins. Wool pulling and making of pickled sheepskins.

5. General outline of tanning operations from start to finish. Lay-out of tannery.

6. Chemical demonstration of action of tanning materials on hide-substance. Details of vegetable tanning and study of vegetable tanning materials.

7. Mineral tannages, chrome, alum, and combinations. Oil tannage. Details and processes.

8. Trip to the Beggs and Cobb plant at Winchester. An afternoon spent in seeing what has been taught. Principally chrome work.

9. Finishing operations. Patent leather. Preparation of varnishes.

10. Trip to American Hide and Leather Co., Woburn Highlands, including a brief visit to the Beggs and Cobb patent leather shop.

11. Lecture, Tannage of goatskins, also manufacture of sole leather.

12. Trip to Benz Kid Co., Lynn.

13. Talk on South America by Mr. H. G. Brock, Special Agent of the United States Bureau of Foreign and Domestic Commerce.

14. Tannage of Sheepskins and Calfskins, also a half-hour talk on the Far East by Mr. Clarence E. Bosworth, Special Agent of the United States Bureau of Foreign and Domestic Commerce.

15. Talk on Sheepskins and exhibition of stock by Mr. L. Y. Stiles at the Sheepskin Department of the A. C. Lawrence Co.

16. Brief outline of history of shoemaking in the United States. Development of machinery and the modern factory. Steps in manufacture up to stitching room.

17. Leather remnants, examination of stock at the C. G. Flynn Co., and talk by Mr. Battey on uses of various kinds of remnants.

18. Illustrated lecture on history of shoes by Mr. Wm. F. Hall of the Publicity Department of the United Shoe Machinery Corporation.

19. Talk and exhibition of calfskins at Calfskin Department of the A. C. Lawrence Co. Talk on 'Tanning,' by Mr. L. F. Peabody; 'Selling the Product,' by Mr. G. N. Bankhardt.

20. Trip to Stetson Shoe Factory, South Weymouth. High grade men's welts.

21. Talk on Shoe Selling and the Manufacture of Rubber Heels by Mr. William Noll of the Foster Rubber Co.

22. Shoe Findings. Talk and Exhibit by Mr. S. R. Nichols of the Frank W. Whitcher Co.

23. Trip to the Thomas G. Plant Co., Jamaica Plain. Women's welts, McKay's and turns.

24. Brief summary of shoe manufacture by the instructor. Remarks by Secretary Anderson of the N. E. Shoe and Leather Association.

Presentation of certificates by Principal Owen D. Evans of the Boston Continuation School.

The Boston Continuation School conducts classes in several local shoe factories, which are of the nature of part time education. In these courses boys and girls from fourteen to sixteen years of age are taught subjects related to shoe manufacture, and Americanization, citizenship, and hygiene. The teaching of factory processes is at present left to the factory itself.

*Training Minor Executives in the Shoe Factory.*¹ The continuity and activity of an industrial organization depend in the highest degree upon trained executive control. Formerly executives in the shoe industry learned their duties mainly by experience in the offices of a factory, with observation in the departments of shoemaking when such knowledge was necessary. All such means of preparing young people to fill important office or department positions take considerable time and are often costly to a firm. Frequently it is found that the person to whom the necessary period of experience and observation has been allowed is after all unfitted to bear the responsibility later imposed upon him.

There has recently been introduced in shoe manufacture a most interesting method of training minor executives, who will provide the higher executives as the years go by. This method parallels the vestibule school in industry. It is intended especially to shorten the time which is ordinarily required for those who enter the employment, planning, or production departments to become acquainted with the organization, policies, and methods of the company. An expert instructor is provided who has charge of classes organized from young persons just entering the firm's employ or from others already in ser-

¹ For a complete description, see 'Training Minor Executives in a Shoe Factory', by Roy Willmarth Kelly, *Industrial Management*, October, 1918.

vice who may have shown desirable qualities and ability for leadership. All receive pay while learning. The period of instruction runs from three to four weeks, varying somewhat according to the special subjects needed by individual members of the course. Instruction is given by means of lectures, demonstrations, use of a special museum, reading, visits to factory departments, and special research problems. The lectures are based on a check list prepared by an investigator who spent several months studying the work of the plant. Special stress is laid upon the relation of the work of one department to another and upon a correct understanding of the fundamental policies of the company. The leading topics of study are substantially as follows:

1. The purpose and explanation of the instruction system
2. The history and organization of the firm
3. The organization, functions, and routine of the service department
4. The instructions given to a foreman
5. Company system, throughout departments
6. Fundamental ideas on which the work of the company is based
7. Individual system and technique
8. Personality
9. Tact and psychology
10. Methods of shoemaking
11. Elements of report forms
12. Theory of organization and management
13. Special technical topics for particular students
14. Observation or practice in actual factory work or processes

Handicapped persons may be admitted to these courses who are qualified to do office work, act as time study men, enter the employment department, or perform other executive duties.

Training or Qualities Necessary for Special Factory Positions. The superintendent of a shoe factory or of a department or room must be first of all a manager. He need not necessarily have exact knowledge of processes, but he must know much of resources, materials, equipment, employees, and of methods of efficiency and improvement in employment conditions. He must be able to work through subordinates and yet keep a firm and helpful hand on the activities of manufacture.

The superintendent usually comes to his position from the business side of the industry. Young men are trained for this work in some factories by a period in office service, of from six months to several years, followed by service in the factory long enough to make them familiar with the general features of manufacture. They then usually become assistant superintendents.

The superintendent's annual salary may vary from some hundreds of dollars in a small factory or department to many thousands of dollars in the great corporation.

The shoe foreman, on the other hand, rises from the bench or is promoted from the machine. He must have intimate knowledge of processes and be able to train employees in them; he must be able to select operators for his department and to make their work efficient; he must be a master of method, of handling men at work, and of maintaining discipline in his room, tactful, firm, friendly with all, yet not forfeiting their obedience and respect.

The position of the foreman is exacting. He stands between the superintendent and the operator and is responsible for the work of his department. He must keep every employee occupied and the work passing through on schedule time. His pay is usually about the same as that of the most expert operators in his room, varying from \$20 upwards a week, reaching \$50 or \$60 in some cases.

There is probably more change of foremen among shoe factories than of other officers or employees.

Forewomen are employed in divisions of the stitching room or in small departments in which the employees are mostly girls or women.

Some factories have, in addition to superintendent and foremen, a person whose special duty is to examine all work being done in a department for its quality of workmanship and another person who observes all work for its quantity, so that each room is held up to the standard set by the factory both in grade and volume of product. These persons are practically assistants to the foremen, yet responsible to the factory management only. With them, the foreman can give his time more fully to training and supervising employees.

The quality and quantity men have about the same rank and pay as foremen.

Some large concerns employ a person skilled in efficiency methods. His work in the factory consists in studying methods and processes so that the best results may be obtained with the least expenditure of time, with the least wear of machinery, and with the most economical use of materials possible. When his duties deal with the operations of manufacture he is usually called an efficiency engineer. He is a specialist in work attended to by the foreman or his assistant in the smaller establishments. In some firms he is known as the head of the planning department and may have from 10 to 30 assistants.

Opportunities for the Handicapped in These Special Positions. The great difficulty in all industry is that of securing executive ability, not only in office managers and their assistants, but in factory superintendents and foremen. There is quite certain to be an improved class of foremen, and similar workers, throughout American industry as the chief result of the rehabilitation of handi-

capped men after the war. In the future a large per cent. especially of foremen in industry will come from the ranks of the disabled soldiers. Many of them will have had superior education and pre-war experience and training, and may learn the nature and routine of certain lines of manufacture and become foremen where physical activities will be at a minimum and mental activity at a maximum. Previous training in shoe manufacture will then be a great asset for one who wishes to reenter that occupation. Some returned men will become inspectors of work done in the departments of the shoe factory. They may also become quantity men and quality men and efficiency experts in the industry.

Such men may have lost both legs and an arm or hand, and have other injuries that prevent manual labor. But they must have good health, unimpaired mental faculties, good eyesight and hearing, and ability to write and attend to office or workroom details with or without the aid of an assistant.

Promotion. The operator who can perform several processes in shoemaking is usually kept upon the process in which his work is most needed at any time. Frequently a worker showing a special aptitude for an advance operation is put forward to learn it, and given permanent promotion if he becomes expert in it. There is not, however, such a gradation of operations in the departments of the shoe factory as to offer promotion regularly or to the many. The most conspicuous promotion is that of a workman who comes to understand the work of a room fully and who has ability to direct others, to the position of assistant foreman or foreman.

XIII. Employment Conditions in the Shoe Industry

Like many other forms of manufacture in America today, the industry is carried on in old and unsanitary factories in some of the oldest shoe towns, and in modern, sanitary buildings in many places. It is found in both urban and rural communities. It draws its employees from the shop and from the farm.

The Sex Division of Employees. At the opening of the European war the sex division of employees in shoe manufacture in this country was substantially as follows:

Male employees, sixty-nine per cent.

Female employees, thirty-one per cent.

Boys under eighteen years, one-seventh or fourteen per cent. of male employees

Girls under eighteen years, one twenty-fifth or four per cent. of female employees

In factories making mostly heavy shoes or men's wear, however, the proportion of male employees ran somewhat higher than the sixty-nine per cent., and that of female employees lower than the thirty-one per cent. On the other hand, in factories making women's, children's, and infants' footwear, there would have been found some increase in the percentage of female employment with a corresponding decrease in the male.

As a direct result of the present scarcity of labor, there is a change of probably about ten per cent. in the relative numbers of male and female employees in the industry—about five per cent. less males and about five per cent. more girls and women who have taken up some of the heavier jobs of the factory. In factories making the

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assurance that he will find a steady market. We find many factories making men's heavy work shoes, leg boots, walking shoes, or shoes for dress wear; and other factories making footwear for women, children, and infants, exclusively. At the same time we find the long list of factories manufacturing special parts and findings.

Piece and Time Payment. Two-thirds, or about sixty-six per cent. of the processes of boot and shoe manufacture, are paid for on a piece basis, usually at a fixed rate per dozen pairs. Such processes are those in which good work can be done at high rate of speed, and in which the possibility of increased earnings produces a larger volume of work from the shoe operator. On the other hand, where accuracy and care are required, as in the cutting room, and where work is of a routine nature, as in shipping, pay rests upon a time basis.

Seasons. One of the chief objections to entering shoe manufacture is the fact that it is largely a seasonal employment. The busiest seasons are the fall and winter; the least busy season is the summer, with an average idle period of from three to eight weeks, coming usually in or around the month of July. As has been said earlier, the progressive shoe manufacturers are making great efforts to obtain orders far enough in advance, and to study trade conditions.

at a year's steady employment may be factory Large concerns capable of may do this more easily; and trade must adjust its and suffers usually from an

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SHOE INDUSTRY

Machine-Making. The working condition of the machine-maker in the shoe factory and the effects of the machine-making processes have been treated at length in the sections of this Bulletin dealing with machine-making. It remains to speak of the ever-present feature of machine employment—monotony. Like the other kinds of manufacture, the machine-making processes are monotonous. The hand of the machine-maker is lighter and less wearing than that of the operator of a lighter and less wearing machine. The work is distinctly characterized by monotony. The operator of an automatic machine, however, upon whom the making of shoes must be placed and confined for a long time period, is depressing and monotonous. In a sense he becomes a part of the machine and he may almost seem to have little individual activity aside from it.

There are several possible offsets to monotony in shoe machine-making. There is an incentive to speed, which, while it is a constant for the workman, has a speeding effect upon him because of payment by piece. He is constantly accomplishing a full day's work in less than a day's time, thus gaining for himself a few hours of the day to spend outdoors or at home. He has nothing to enter the gang room of a shoe factory towards night and find some of the operators upon them have accomplished the lots of shoes passing through the machine.

There is also the advantage to the operator of the machine, so that at times he can move from one to another. It is also a constant to the mind of the worker to see the various shoe materials of high quality and the various shoe materials of high quality.

Another means of lessening monotony lies in the operator's being able to care for his own machine, to understand its parts, or to suggest improvement upon it. This kind of ability, which is much sought after in the shoe factory, often leads to promotion and to work upon more important machines.

In some factories the routine of the day is broken by a rest period in the morning and in the afternoon. In a western factory, which makes supplies for the shoe trade, there is a morning and afternoon recess for employees. Lunch is served during the recess. Some of the employees work as waitresses. In a number of shoe factories there are now rest rooms open to women at all times of the day.

Service Work in the Shoe Factory. Some large factories conducted under modern conditions take measures for the occupational and social welfare of their employees. They provide classes for training, in some features, at least, of the work of the factory; separate rooms for rest and recreation; dancing, and social clubs for male and female employees; libraries equipped with books and magazines relating to shoe manufacture, and with general literature; restaurants conducted on a cooperative basis, or at low rates, so that employees can afford to patronize them; medical attendance and equipment; and sometimes elaborate parks, playgrounds, and club houses.

The best summary of service work in the shoe industry is to be found in the report upon *Employers' Welfare Work*, published by the Bureau of Labor Statistics, as follows:

The Shoe Company has done much to improve working conditions for its 5,000 employees. The huge factory is built in the form of a hollow square, so that all the work-rooms are well-lighted. On the top floor, where the shoe leather is cut, the roof has saw-tooth skylights to increase the light. The ventilation throughout the building is admirable, and every effort is made to keep down dust. The lavatories are very

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sanitary and clean. Individual lockers of perforated iron are placed about in the workrooms near the machines, and are turned over to employees on their making a small deposit—enough to cover the cost of the key. There is a check-room for umbrellas and wet garments. Separate elevators are installed to transport the women employees to the upper floors. The company has a lunch counter for the employees, where food is sold at cost. Employees who bring their lunches eat them in the workrooms.

Apart from good workroom conditions the company conducts recreation work—the name it gives the usual welfare work. The ground around the building has been converted into a noonday-rest park for the employees, with a beautiful, trim, green lawn and flowers. There is besides a roof garden covering over half of the roof space. Part of this is reserved for women and part for men, with separate stairways leading to each section. A dance hall for women open at noon and on special occasions in the evening, a pool room and bowling alleys for men, open every evening after working hours until ten o'clock, give the much-needed amusement. The men pay a small fee for the use of the tables and the alleys. A handsomely furnished reading room, with attractive ferns and flowers from the company's greenhouse, has been opened to the employees. There is a branch station of the City Public Library here, besides books owned by the company and numerous weekly and monthly periodicals.

A woman physician, constantly in attendance, has the medical care of the employees under her supervision. There are rest rooms and an emergency hospital, with a nurse regularly employed, in the building. Twice a week an oculist spends the forenoon at the factory and may be consulted free by the employees. He fits them with glasses at very reduced prices.

The company, with the aid of employees' dues, maintains the Relief Fund Department. Out of this fund, sick, accident, and death benefits are paid. There is at present over \$5,000 in the treasury. The dues are ten cents each week for adults and five cents for employees under twenty years of age, and they

are deducted from wages by the paymaster's department. In case of sickness or accident the members receive \$7 and \$3.50 a week. No member can draw benefits longer than seven weeks in one year. Benefits do not become due until the member has been incapacitated one week, except in case of severe injury. At death \$100 or \$50 is paid the beneficiaries of the deceased, according to the amount of the weekly dues. A medical examiner is employed to report upon the condition of disabled members and to decide upon the members' claims for benefits. The administration of the relief fund is entirely in the hands of the company, and all the receipts of the fund are held by the company in trust for the relief department.

Union Shoe Repair Company, Toronto, the Wood Shoe Company, the Williams Shoe Company, and the Askew Shoe Company, of Hamilton, Ontario.

Training in the industry has been given in England in the military and orthopedic hospitals, such as the Royal Pavilion Hospital, Brighton, the Convalescent Hospital, Roehampton, and many others; at technical colleges and institutes, such as the Brixton Polytechnic Institute and the historic Cordwainers Technical College of London, and in shoe shops and factories throughout the country. In France similar training has been provided in the reeducation schools of Paris and other towns and cities and in technical schools and workshops. The industry has been taught to disabled men in several Belgian schools and in a considerable number of Italian schools, as at Turin, Spezia, Pisa, and Milan. Germany has taught shoemaking to many of her returned soldiers in the workshops of the Army Clothing Department and in the hospitals and schools of many communities. Austria-Hungary, also, has given special attention to teaching the making and repairing of footwear in her reeducation and trade schools.

The work done in all of these countries in various lines of reeducation is of very great interest to America in her problems of reconstruction. We shall here, however, give space only to a short presentation of methods and accomplishments in France and Great Britain.

A French official census, covering fifty-six reeducation schools, has shown that on June 30, 1916, of 2,846 disabled soldiers undergoing training there were 466 shoemakers, this being the largest single trade group. In the National School at St. Maurice, Paris, 152 men attended the shoemaking section during the first two years when the total attendance of the school was 803; of the 152, there were 143 men with leg or foot injuries; 55 men were

former peasants. In the school of the Rue du Epinettes, 60 men, out of a total of 150, were attending the shoemaking shop; 143 shoemakers had been placed by the school, up to June 1, 1917, out of a total of 340 graduates in all trades. Of these shoemakers almost all were suffering from leg injuries. Former peasants, numbering 27, formed the largest preoccupational group. In the Lyons school, the first reeducation school created in France, shoemaking at once proved the most popular trade. There were in this school, in the first year, 50 men in the shoemaking shop, of whom 29 were former peasants. At the Tourvielle branch of the Lyons school on May 31, 1917, 60 shoemakers were graduated, out of a total of 129 men for all trades, of whom 34 were former peasants. Almost all of these were cases of lower limb injuries, 35 were cases of leg amputation, one man had both feet amputated, and two were legless.

Dr. Borne, the noted French authority, in his general reeducation scheme, gives the duration of apprenticeship in shoemaking as from one year to one year and a half. In actual practice, however, both the duration and the methods of training vary from one school to another. The apprenticeship is generally intensive; after a short time the student, while at school, is able to do useful work; many of the schools are, therefore, in a position to fill outside orders and to be to a larger or less extent self-supporting. Thus, while in Nancy the apprenticeship is of six months, it lasts from twelve to fifteen months at the Montpellier School. At Bourges, the apprenticeship is from four to six months for repair work, and from ten to twelve months for the making of new shoes. At the Saint-Maurice School, the length of apprenticeship is, on the average, five months for repair work, and eight months for the making of new shoes. The course is divided into three sections of practical instruction. A month's training

is allowed for plain machine stitching, seaming, welting and soleing. At the end of five months apprentices should be able to re-sole shoes, both pegged and hand-sewn. Complete shoes are made by men of average ability by the end of eight months. The men receive, in addition, theoretical instruction in branches essential to carrying on the trade, such as study of foot-forms, a knowledge of leathers and the taking of measurements.

At Port-Villez, the shoemaking shop is divided into two sections: repair work and the making of new shoes. During the first two or three months, all students work on repairs; by the end of one week the apprentice is sometimes able to perform useful work. The majority, however, pass into the shoemaking section. After five and one-half months, men who came from other trades are able to make perfectly good military boots. All the orthopedic boots for the Institute are made by the apprentices of the shoemaking shop.

At the Tourvielle School, the apprenticeship is from ten to fifteen months. The apprentices are first taught to make their own shoemaker's stirrup and glove. In doing that they learn how to make a waxed thread and to use the awl. Next they are directed to assemble and sew by hand the parts of a pair of slippers, which they are allowed to keep for their own. Coarse brogans are their next problem and then fine boots. After a month's training the student can feel that he is a shoemaker—he has made a pair of shoes for sale, with the help of the teacher of the course. After ten months or a year, he needs only some final lessons on cut and style, on the selection of material on the way to obtain customers and on price fixing, to be able to get along by himself. If his physical condition permits, he can also have some practice with shoe machinery, which has been supplied to this school by the United Shoe Machinery Company of France.

In Great Britain, both the making of hand-sewn shoes and the factory shoemaking trade have been included in the so-called 'special trades', in which the training and employment of disabled men are of considerable importance and require special regulations. These regulations have been worked out for each trade by a Trade Advisory Committee formed of representatives of employers' organizations and labor unions.

The report of the Trade Advisory Committee on the Hand-Sewn Boot and Shoemaking and Boot and Shoe Repairing distinguishes between two classes of disabled men: (1) Those unable to stand continuously at their work, and (2) those able to stand continuously. For the former, the report recommends training in all branches of hand boot and shoe repairing, and in riveting and finishing; for the latter, training in hand work is recommended as the best introduction to machine boot and shoe repairing, and also training in the use of machines used in the repairing trade, in view of the fact that a large amount of repairing is already done by machinery and that this method may possibly grow in the future.

The several processes suitable for the different types of disability are as follows:

(1) Hand-Sewn Boot and Shoemaking and (2) Hand Repairing. This work can be done sitting and would be quite suitable for a one-legged man. Full use of both hands and arms is needed, but the loss of one or two fingers would not disqualify. Good eye-sight is required. Men suffering from shell-shock may in some cases be likely to find this a suitable occupation. It is not recommended for men with a tendency to consumption.

(3) Machine Repairing, which includes three processes: (a) *Bench Work*. This is done either standing or sitting, but in other respects the requirements are the same as for hand work. (b) *Machine Stitching*. It is standing work, and often

a treadle has to be compressed by the right foot to start the machine and hold down during the operation. Both hands are required. The work is light and there would be only slight vibration. *c Finishing by Machine.* It is principally done standing, but the machine can be adjusted so as to be worked while sitting. Use of both arms and hands is required, but little or no movement of the leg or body. The work is not heavy, but it is not recommended for a man with a weak heart or a tendency to consumption.

The training is provided in technical schools or other training institutions, or in some cases in workshops. The duration of the training in a school is not to exceed twelve months, but in exceptional cases it may be completed by an additional six months' training under an approved instructor in a workshop. The period of training in a workshop is eighteen months for shoemaking combined with shoe repairing, and twelve months for shoe repairing only.

The first month of training is, in all cases, a trial period. If at the end of this period the man proves unsuitable for the trade, his training ceases. The employer is required to pay the apprentice a minimum wage, which, in the eighteen months' course, is fixed at 10s. per week during the first six months, 15s. during the next six months and 20s. during the last six months. In the twelve months' course, the employer shall pay no wages during the first six months, and shall pay 15s. per week during the second six months.

One of the first technical schools to institute special classes for disabled soldiers in the making of hand-sewn shoes was the Cordwainers Technical College. The following classes are open:

1. *High Grade Boot and Shoe Making.* This course extends to at least twelve months and covers the following syllabus:
The making of men's and women's hand-sewn boots. The making of ~~men's~~ ~~and women's~~ rounds. How to take a measure of a cus-

customer's foot, and fit up lasts for the same. How to send a measure to the upper maker or manufacturer. The selection and purchase of bottom stock. How to cost the finished work. The anatomy of the foot.

2. *High Grade Boot and Shoe Repairing.* This course extends to at least six months and covers the following syllabus:

The methods of repairing men's and women's hand-sewn boots. The repairing of machine-welting boots. The repairing of sew-rounds, etc. Patches, blind stitching, and other stitching. Grafting, costing materials and work.

In factory boot and shoe manufacture, according to the Trade Advisory Committee, "as a result of the development and use of specialized machinery and tools, many of the processes are of a comparatively simple character, not calling for great physical exertion and suitable for the employment of disabled men of a fair degree of intelligence. The work is not heavy, but requires concentration and adaptability. The operations generally require the full use of hands and arms, but many operations would be suitable for a man with an artificial leg, provided he is able to stand at his work."

The report of the Committee indicates the following processes suitable for different types of disability:

1. *Clicking Department.* For pattern grading, hand clicking and power eyeleting, both hands and arms must be uninjured, but the operations would be possible for a man with an artificial leg. For the clicking press young men are required whose hands, arms and legs are sound.

2. *Rough Stuff Department.* For the cutting press and roller, young men are required whose hands, arms and legs are sound; for grading machines and splitting machines the loss of a leg would not necessarily disqualify.

3. *Preparation Department.* For sole molders, out-sole, and in-sole channeling machines and power skiving the full use of hands, arms, and legs is required; work especially suit-

able for young men; a man with an artificial leg would not be debarred.

4. *Making Department.* For pulling-over machine, control tacking, pounding machine, Blake lining, standard screwing, loose nailer, stitching machine, leveler, heel attaching machine, loose billing, universal slugger, welt sewer, sole layer and rough rounder, young men are required who are sound in both hands, arms, and legs. Hand tacking is also suitable for older men. Work at the rough rounder and welt sewer should be confined to men who have had some experience in the trade.

5. *Finishing Department.* Heel trimming, edge trimming, edge setting, and bottom scouring are suitable for men with an artificial leg, but both hands and arms must be uninjured. Heel scouring and heel burnishing require young and active men whose hands and arms are sound; an artificial leg would not necessarily disqualify.

The course of training in any process shall be divided into a probationary period and an improver's period. The probationary period must, as a general rule, be spent in a technical school, though in exceptional cases the Local War Pension Committee may permit the man to spend it in a factory. The improver's period shall in all cases be spent in a factory.

The length of training varies for the different processes. It ranges from twelve weeks for power eyeleting to fifty-two weeks for hand cutting.

During the training in a factory the employer shall pay the man a minimum wage, according to a graded scale prepared by the Trade Advisory Committee, and ranging from 10s. to 25s. a week.

While undergoing training in any trade, the disabled soldier receives from the Ministry of Pensions the difference between his wages and the pension paid for total disability (27s. 6d. per week for a private). His wife

receives a separation allowance and a maintenance allowance for each child. The Ministry of Pensions assumes the payment of all tuition fees and other expenses entailed by the training.

For every trade there have been created local Technical Advisory Committees, formed of representatives of employers' associations and labor unions, which select candidates for training, examine the suitability of the training offered in the technical schools or similar institutes or in the factories, and receive applications from employers for the supply of men after training.

The question of wages to be paid disabled men after training is to be settled entirely by the Local Technical Advisory Committee, or by Special Advisory Wage Boards which are being created by the Secretary of Labor in the principal towns.

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Plant of the United Shoe Machinery Corporation, at Beverly, Mass.

XV. Shoe Machinery

The Number of Processes in Shoemaking. In making an ordinary shoe today there are one hundred and seventy-four machine operations performed upon one hundred and fifty-four different machines, and thirty-six hand operations, altogether two hundred and ten processes. About three hundred different machines are in use in the industry, and the number of processes is on the increase.

The Invention of Shoe Machinery. Shoe manufacture has been revolutionized by the invention of machinery through three-quarters of a century. One machine after another has been perfected until the dexterity of the human hand has been attained. Most of the machines have been invented by shoe workers themselves, after long toil and study upon particular operations. Since the establishment of the United States Patent Office in 1836, about 7,000 patents have been granted on shoe machinery.

There have been three conspicuous stages of development in shoe machinery, as follows:

1. The Upper-stitching Machine, for sewing the top parts of the shoe.
2. The Sole-sewing Machine, for attaching the soles to the uppers.
3. Machine Welting, an improved method of sewing the sole to the upper.

The other machines used in the industry mark steps of advancement in minor processes and features of shoe manufacture.

Making shoes by hand, however, has continued to the present day, though steadily diminishing in importance. On the other hand, shoe repairing has been a hand indus-

try until very recently. In large communities machine repairing has come into practice.

The Wooden Peg: 1815-1857. As early as the sixteenth century heels were attached to shoes by wooden pegs made by hand. Preceding the use of shoe machines a machine for making pegs was invented in 1815. This small invention was a great gain and suggestive of machines for actual shoemaking processes. A pegging machine was invented in 1833 and came into general use about 1857. The pegging machine and the McKay sewing machine revolutionized the industry.

The Rolling Machine: 1845. The first machine widely used in the industry was the rolling machine for solidifying sole leather. Up to this time the shoemaker had been obliged to pound sole leather upon a lap stone with a flat-faced hammer to make it firm and durable for the shoe bottom.

The Howe Sewing Machine: 1852. John Brooks Nichols, a Lynn shoemaker, adapted the Howe sewing machine to stitch the upper parts of shoes, and this machine was first used in Lynn in 1852. The introduction of this machine marked the transfer of stitching from the homes of shoe workers to the factory, marking the first stage of development.

The McKay Sewing Machine: 1858-1862. In 1858 Lyman R. Blake invented a machine for sewing the soles of shoes to the uppers. After improvements this machine was manufactured by Gordon McKay, of Cambridge, Mass., and became known as the McKay sewing machine. This machine was first used in Lynn about the year 1862. It marked the second stage of development in shoe machinery. It is the most important invention of all in modernizing shoe manufacture.

The Goodyear Welt Machine: 1862-1875. In 1862 Auguste Destouy, a New York mechanic, invented a

machine with a curved needle for sewing turned shoes. Charles Goodyear employed mechanical experts to improve this machine and it was finally adapted, in 1875, to sewing a welt cut in the bottom of the shoe to the top of the shoe. It became the famous Goodyear Welt machine and marks the third great stage of development in the industry.

McKay and Goodyear were far-seeing capitalists and manufacturers. They improved and patented the inventions of obscure shoe workers who had no means of perfecting their crude machines, and in a large degree created the modern industry, making the country and the world forever their debtors.

Edge-trimming and Heel-trimming Machines: 1877. Machines for trimming the edges of the sole and the outside of the heel of a shoe were first used about the year 1877. These processes were difficult and had previously been done by hand, at very high wages. Hand trimmers, or 'whittlers', as they were called, opposed the introduction of these machines but their uniformity of work and saving to the manufacturer made their use invaluable.

Right and Left Patterns: 1876-1880. Up to about this time, through all the period of which we have written, shoes for both feet were made upon similar lasts, without right and left shape. Both hand shoemakers and factory manufacturers had followed this custom. The purchaser of a new upper of shoes wore them as he pleased, having no right and left form to determine upon which foot each shoe should go. A pair of shoes made on right and left patterns was exhibited as a curiosity in the Centennial at Philadelphia in 1876. Such patterns came into general use about the year 1880.

The Lasting Machine: 1883. Shoe operatives in all lines opposed the introduction of machinery into the industry. They felt that it would reduce the number of

workers, shorten the period of employment each year, and make them more dependent upon the manufacturer. The hand lasters were foremost in this opposition. They were strongly organized, and earned from \$20 to \$30 a week at a time when earnings in most processes were very low compared with present day wages in the shoe factory. Jan Ernest Matzeliger, a young machinist of Lynn, learned to operate a McKay sewing machine and undertook to invent a lasting machine. He was successful, after four attempts, and in 1883 gave the industry what has become the modern 'Consolidated Lasting Machine'. Some of the motions of this machine are like those of the hand and fingers, drawing the parts of the leather into place and fastening them by tacks.

The Pulling-over Machine. This machine was introduced early in the present century. It prepares the shoe for the lasting machine. It centers the upper on the last, draws the parts into place with pincers and fastens them with tacks for lasting. "It is the acme of shoe machinery intricacy and accuracy, and years of study and over \$1,000,000 were spent in its development."

Power in Shoe Manufacture. Hand and foot power were long used in the first primitive shoe factories of the country. In 1855 William F. Trowbridge first applied horse power to shoe manufacture in what is now Marlboro, Mass. After that time steam and water power came into general use in shoe factories. In 1890 the electric motor was introduced and has gradually taken the place of the steam engine.

The Leasing System and the United Shoe Machinery Corporation. The leasing of shoe machinery was introduced in 1861 by Gordon McKay. He found it difficult to sell the Blake Shoe Machine to shoe manufacturers and compromised the difficulty by hiring the machines out to them. The leasing system, which was conducted on a

royalty basis, enabled the manufacturers to have the advantage both of the use of the machine and of unreduced capital for manufacture. This system has been perfected and enlarged by the United Shoe Machinery Corporation of Beverly, Mass. This corporation now owns a large portion of the shoe machinery in operation in this country. After a long contest in the Supreme Court of the United States the decision has been reached that this corporation is not a monopoly in restraint of manufacture. Without doubt a large proportion of the 2000 shoe factories of the United States exist only by virtue of the advantage of the leasing system of shoe machinery.

The Standardization of Machinery. The leasing system has caused the standardization of shoe machines and processes of manufacture. As a result, the growth of the industry during the last twenty years has surpassed all former periods. Standard shoe machines are now in quite general use in this country and in many factories in other countries. It should be remembered, however, that improvements are constantly being made, and that a process may be entirely changed at any time. The United Shoe Machinery Corporation keeps a corps of expert machinists and inventors constantly at work upon the thousands of patents which it holds. It also maintains a large force of expert 'road men' in the large shoe manufacturing centers. These men install machines in shoe factories and make the larger repairs which are necessitated by wear and breakage. In late years the service of the corporation has been extended to the instruction of operators upon the machines when set up in the factory.

Operating a Complicated Shoe Machine. The operator of a modern complicated shoe machine must understand its parts thoroughly. He must be able to adjust it and make simple repairs, at least, at any time. The operator,

then, of most shoe machines should have some mechanical ability, though he usually learns to adjust and repair his machine by actual experience in running it. The operator who has real mechanical ability is worth more to the factory, and has increased earning power under the prevailing system of piece work.

Index of Disabilities and Occupations

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Publications of the Red Cross Institute for
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June 14, 1919

Number 9

Opportunities for Handicapped Men
in the Rubber Industry

By Bert J. Morris and Charles H. Paull

Bureau of Vocational Guidance

Division of Education

Harvard University

Prepared by the
Bureau of Vocational Guidance
in Cooperation with
Red Cross Institute for Crippled and
Disabled Men, New York

The Red Cross Institute for Crippled and Disabled Men
311 Fourth Avenue New York City

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Opportunities for Handicapped Men in the Rubber Industry

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Courtesy, Boston Rubber Shoe Co.

*A one-armed man in the machine
repair shop of a rubber factory*

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Foreword

A FAIR trial of handicapped labor necessitates a right attitude on the part of both the employer and the employee at the start. While the purpose is to put the men in places where they will be fully efficient, attempts to so place them will be futile unless employers, superintendents, foremen, and fellow workers are patient with the handicapped men until they become thoroughly adjusted to the new conditions. Even though a disabled person is carefully trained and well-equipped to do certain work, it will, as a rule, take some time for him to reach his highest efficiency. Until that time, at least, he will need encouragement from all with whom he is associated.

The Use of Appliances by Injured Men. In order to simplify the discussion of disabilities in connection with the various operations in the rubber industry, it has been assumed in each case that where a member has been lost a suitable appliance will take its place. It is not within the scope of this discussion to speak in detail of the possible appliances. However, where there has been any doubt as to obtaining a desirable appliance in connection with any operation, this particular operation has not been recommended. It will, therefore, be assumed that where a man has lost a leg, an artificial limb will take its place. The character of the artificial member will, of course, depend on the sort of work which will be done. The same rule will hold for loss of hands or arms.

The Problem of Wages. In cases where wages are mentioned, they represent as nearly as possible those wages which were being paid at the time of the writing of this article. These figures are, therefore, somewhat limited in their value, and employers refrain from making an

estimate of what wages may be after the war ends. Perhaps the only value of studying the wages lies in a comparison of wages paid in various operations. The general relations here would probably remain about the same should there be a change in the scale. Another factor in connection with wages as they are stated is that they apply at the present time to able-bodied men. As nearly as possible, this investigation recommends men for operations only when it seems probable that they will be able, in the course of time, to perform them with a reasonable amount of efficiency. On the other hand, it must be borne in mind that these men will have to acquire dexterity in using their artificial appliances. Their ability, then, to reach the maximum of usefulness will depend on (1) the seriousness of their injury; (2) whether this injury is combined with other injuries; (3) their native dexterity in motion and manipulation; (4) the amount of training they have had since the loss of their members; (5) the willingness of the shop foremen and fellow workers to give them special assistance; (6) the general attitude of mind of the individual as determined by home and social environment.

The Time Required to Learn Specific Operations. Considering these various factors, it becomes apparent that the length of time for training in various operations will vary considerably in different cases, so that the length of time stated for acquiring a fair knowledge of each operation must be considered as only an approximation, and disabled men must not feel discouraged if they find that it requires longer for them to learn their work than has been suggested.

In factories employing an industrial engineer, there is a marked opportunity for the re-arrangement of work for the special accommodation of disabled men. The study of such points as the placing of material, the variation of

operation, and the location of machinery ought in many instances to result advantageously not only for the operator, but also for the factory.

Nationality of Workers. Instead of discussing nationalities in connection with the several operations, it seems more desirable to make a brief statement in the introduction. Rubber plants at present employ a great variety of nationalities in their various departments. Important among these are American, Italian, Polish, Austrian, Russian, Armenian, French Canadians, Lithuanians, Greeks, and Germans. Since the beginning of the war some factories have introduced negro labor. Different nationalities predominate in different factories, although American, Italian, Lithuanians, and Polish workmen form the majority in most instances. In very few departments are all the men Americans, though there seems to be a tendency for the Americans to take the lighter operations. In the heavier work in the mills there is a divergence of preference of foremen for various nationalities. Some plants speak highly of their Polish mill hands, while others favor Americans or Italians.

The following statistics covering a number of footwear factories show how wide is the distribution of nationalities in the rubber industry:

1. Number of employees:

Male	9,800
Female	<u>9,000</u>
Total	18,800

2. Per cent. of Various Nationalities in Factories:

Americans	50%	Poles	6 %
Armenians	1	Portuguese	3
Austrians	2	Russians	5
Canadians	4	Scandinavians	3

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Finn	1%	Turks	.5%
French	.5	Miscellaneous	.7
Germans	2	Swiss	.1
English	3	Syrians	.1
Greek	1	Hebrew	.1
Irish	6		
Italians	8		
Lithuanians	3		

3. Per cent. of Foreign Nationalities in Departments:

Mill	15%
Cutting	33
Making	45
Shipping	33½

Opportunities for Handicapped Men in the Rubber Industry

The rubber industry offers a variety of occupations in which handicapped men may find profitable employment. Especially is this true in regard to unskilled and semi-skilled workmen. Although certain features of the work, such as long hours, heavy lifting, and continuous standing are disadvantages not to be overlooked, the industry on the whole possesses most of the characteristics generally considered of first importance in selecting desirable occupations for disabled soldiers and sailors. These important characteristics are: Substantial growth, increasing demand for workers, steady employment, essential products, and a high standard of wages in proportion to the length of time required to learn the operations. These features assure the worker of continuous, steady, satisfactory employment at reasonable wages—the very things that mean most to handicapped men.

The Growth of the Industry. The industry has had a substantial growth for several decades past. For a few years previous to 1909 there was a noticeable decrease in the output of certain articles but this was only temporary, and for the last six or seven years the industry has been developing rapidly along all lines. As no rubber is produced in the United States, the amount of crude rubber imported is an accurate gauge of the growth of the industry. In 1907, the imports amounted to 63,006,352 pounds, while, in 1917, the amount was 341,537,322 pounds; an increase of over 442 per cent. in ten years. The same story is told by the value of manufactured articles exported. During the decade from 1899 to 1909

the value of the exports of rubber boots and shoes increased 21 per cent.; of mechanical goods 259 per cent.; of sporting goods 204.6 per cent.; and of dentists' materials 191.2 per cent. The value of the total annual output, likewise, shows the same growth. In 1909 the value of all products was \$224,373,321 while in 1917 the value was \$465,516,248; an increase of almost 300 per cent. When we turn to the number of employees and the amount paid in wage earnings, the same substantial growth is evident. The increase in the wages paid in 1909 over the amount paid in 1899 for the manufacture of boots and shoes was 22.4 per cent.; for mechanical goods 212 per cent.; for sporting goods 138.1 per cent.; and for dentists' materials 54.7 per cent. The number of wage earners increased from 57,346 in 1909 to more than 240,000 in 1917; an increase of over 300 per cent.

The Scope and Future Development of the Industry. There are, all together, more than 50,000 articles made of rubber. When the industry was first established, the output was confined almost entirely to waterproof clothing but, after chemists discovered how to compound various ingredients with rubber and by that means produce a material readily molded into any desired shape, the industry rapidly expanded so as to include many other lines of manufacture. The field is so large today that the work has naturally been subdivided into a number of distinct branches. In addition to rubber footwear and surface goods, the most important of these are the manufacture of mechanical goods, such as hose, belting, cables, valves, insulating compounds, gaskets and tubings; hard rubber goods, such as battery jars, electric supplies, combs and fountain pens; medical goods, such as dentists' sundries, hospital sheeting, bandages, blankets, bottles, gloves, and surgeons' equipment; sporting goods, such as footballs, striking balls, and tennis balls; pneumatic tires and tubes and

solid tires for carriages and motor vehicles. Since the outbreak of the war, two other important divisions of rubber manufacture have developed. One is aircraft equipments, including rubberized fabrics for balloons, airplanes, and parachutes. The other has to do with materials used in gas defense, such as gas-proof cloth and various molded parts necessary for making masks.

The future development of the industry is practically unlimited and depends upon new discoveries in the chemical laboratories. "In the light of past developments," to quote an authority on rubber manufacture, "it is not such a long stretch to the time when the rubber tire will meet a rubber pavement and the rubber sole will walk on a rubber sidewalk. This time, in fact, is nearer than we think. Experiments in rubber pavement have now been carried on for twenty years and they have proven satisfactory from a practical standpoint. Cost is the only barrier at the present time—and the price of rubber is going down while the price of other materials is going up." Other leading men in the industry say that we may look for the application of rubber to the manufacture of furniture, flooring, roofing, and many other parts of buildings for which wood is now being used. Developments of this kind would only be in line with what has already taken place in Europe. While the rubber industry has reached enormous proportions, it is still in its infancy, and it is not unreasonable to expect that the growth will be more rapid in the coming years than it has been in the past.

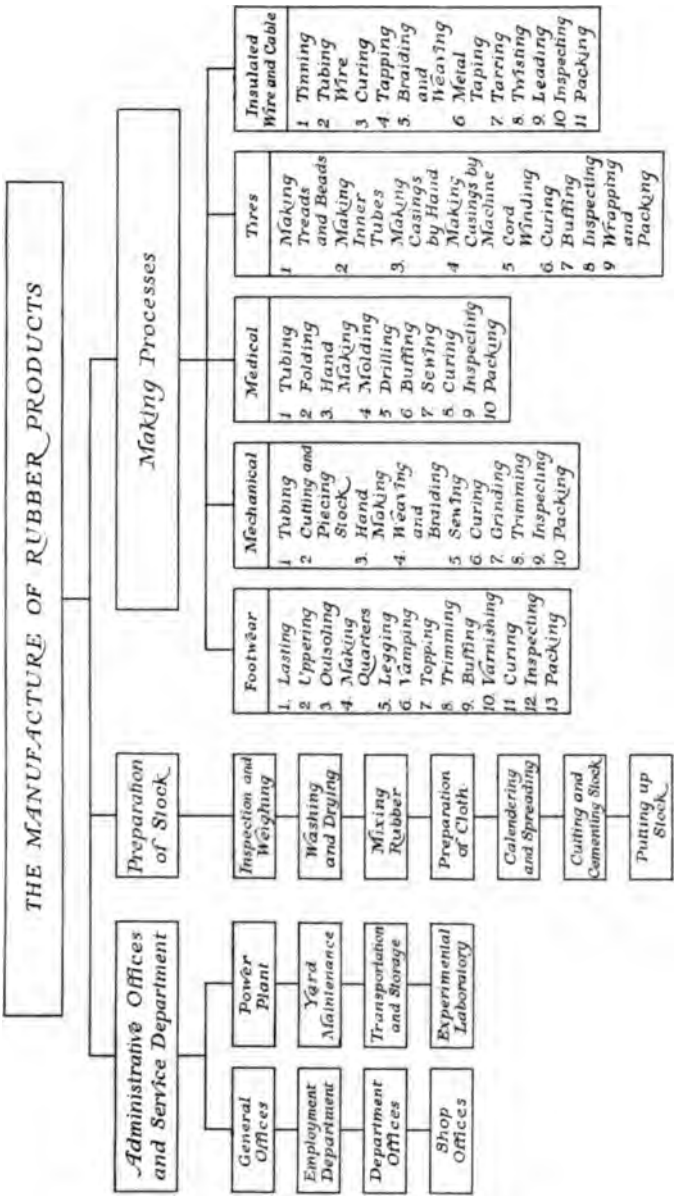
The Source of Rubber. Rubber is obtained from the milk or latex of a variety of trees which are native to Central and South America, but which thrive under cultivation in practically all tropical regions. The latex is not the sap of the tree, but a substance which forms between the outer and inner layers of the bark. It develops so

rapidly that trees can be tapped every day for a period of nine or ten months during the year. Though the latex resembles milk in appearance, it readily breaks up on standing into a liquid and a soft, sticky, gum-like substance. For commercial purposes the liquid is evaporated by the application of smoke or various acids, leaving a product known as crude rubber.

A Modern Rubber Factory

There are at the present time in the United States more than 500 rubber manufacturing plants. They vary, of course, in size and details but have similar equipment and follow about the same procedure of work. Whether the plant is large or small, all of the preparatory processes, such as washing, drying, mixing, calendering, and cutting have to be done. This work requires expensive machinery. In order to receive a reasonable income on the immense outlay of capital, a large output of manufactured goods is necessary. For this reason, most modern plants are operated on a very large scale, employing from several hundred to several thousand workers. A typical plant is really a fair-sized community requiring plans of control and supervision in regard to sanitation, housing, and transportation as well as in carrying out the various operations inside of the plant.

The fact that the rubber industry has grown so rapidly in recent years has tended to produce modern buildings in most rubber plants. There are still to be seen a few of the older type of structure with their poorly lighted and ventilated rooms and narrow and inconvenient stairways. In the newer buildings, however, working conditions are excellent. The window space is large. Many of the rooms are finished in white paint, which adds to the light and general cheeriness of the place. As far as is possible, the



floors are kept clean. Modern fireproof stairways and sprinkler systems add to the safety of the workers. Drinking fountains are placed at convenient intervals throughout departments, and toilets are located on each floor.

Many of the newer buildings are arranged in the unit form and are usually three or four stories in height. This gives air and light space between buildings and facilitates the enlargement of the plant when desired. A number of companies have taken steps in various ways to add to the attractiveness of their buildings and grounds. Where space is available, shrubbery and trees have been planted, and lawns have been laid out.

To secure the best results in plants where large numbers are employed, a well organized administrative system is necessary. The general manager who has oversight of the entire plant must have department superintendents whose duty it is to look after specific parts of the work, such as purchasing materials, production of goods, maintenance of plant, and employment and welfare of workers.

Facing page 12 is a diagram showing the organization of a plant employing approximately 10,000 workers. Smaller plants would differ from this only in the extent of the organization. Many of the administrative functions designated in the diagram might be combined under one official, and all the preparatory processes might be done in one department. The making processes would vary with the lines of articles produced; some companies making shoes only, some mechanical goods, some medical goods, and some automobile tires.

In connection with the service department of many companies, various welfare and educational projects have been undertaken. Lunch rooms have been provided; recreational activities have been encouraged; and lectures on popular subjects have been offered at noon hours and

other times. Social and athletic organizations have been formed. Some companies employ visiting nurses in connection with their health and medical work. Where a large number of non-English speaking workers are employed, various schemes for teaching English have been undertaken with varying degrees of success. All these activities have been of immeasurable value to the employer on the one hand and to the employee on the other. They have assisted in re-establishing the spirit of confidence and understanding which the rapid development of our industrial system has tended to do away with.

Some rubber companies draw their help from a considerable area, while other companies form the center of the working community. In the latter case, there is a larger community interest existing between the industry and the worker, and this affords an opportunity for the industry to take an active interest in housing schemes, assisting their employees by providing houses for rent, or loaning money for the purchase or building of houses.

As the administrative work is very similar to that of any large industry, it has not been discussed in this bulletin. The operations in connection with the preparation of the stock and the making processes are treated in detail in the following sections of the report. After each operation has been described, a brief statement is made concerning the time required to learn the work, the average wages paid at the present time, the opportunities for advancement, and the suitability of the work to various handicaps.

Provisions for Training Workers

The method of training workers followed in most plants until very recently was to start a green man at a table with an experienced worker. Fair results have, in the past, been secured in this way but several disadvantages have

come to light. As the making of rubber goods is largely done by piece-work, few men have been willing to take the proper time thoroughly to instruct a beginner. If the worker does not turn out the usual amount of work, he, of course, receives less pay. This is offset partly by the fact that the work of the beginner is credited to the experienced man. For a few days and sometimes for a week or more, however, the work of the beginner does not compensate for the time lost on the part of the regular worker. Another disadvantage is that too frequently persons who are good workers are poor instructors, with the result that the best methods of making rubber goods are not taught. This is really a serious disadvantage as it manifests itself in both the amount and quality of output. Another disadvantage is that this method fails to develop uniformity in instruction, without which a high standard of quality is hard to maintain.

A Shop School. Many establishments have recognized these disadvantages and are taking steps to overcome them. The Hood Rubber Plant at Watertown, Mass., has established an apprentice school for footwear makers. All women beginners must pass through this school before taking up regular work in the factory. The school was established in April, 1917, and has grown until, at the present time, sixteen regular instructors, in addition to the superintendent, are employed. The school started in a small way. A room was set apart for the work and regular making tables were installed. One of the leading floor ladies of the making room was put in charge. From the very first, the school became popular, and soon it was decided that all women desiring to take up work in the making room would be given instruction in the school.

The present plan is for one instructor to care for four beginners. She does not take four beginners at the same

time, but has them at different stages in the learning processes.

The first process to be taken up is that of lasting. Even those who wish to be upperers begin with lasting. After they become familiar with this work, they can pass on to the work of uppering. Beginners are paid \$9 a week from the time they start. No raise in wages is given until the person is able to make more than half of a regular ticket. For every six pairs more than half of the regular ticket, the worker's pay is increased 70 cents per week. The increase is continued at this same rate until the worker is able to earn \$12 per week. She is then transferred from the apprentice school to the regular factory and put on piece-work. Most persons who pass through the school are able, in a short time, to make as high as \$15 or \$16 a week. The system has proved very satisfactory. The apprentice school is popular, and, though it requires sixteen instructors who might be used as floor women in the making department, it is an economical method of teaching beginners. New girls waste very much less material under instructors in the school than they do learning from workers in the regular factory. Furthermore, the girls advance much more rapidly, and this is a great advantage to the company as well as profitable to the workers. The real success of the school, no doubt, is due largely to the splendid work of the superintendent. Knowing the work at first hand, and possessing the qualities of a good teacher, Miss Clark is very popular among the girls and has put the school on a permanent efficient basis.

A Normal School. The United States Rubber Company, at its plant in New Haven, Conn., is working along very novel lines in the way of providing instruction for workers in their footwear factories. The work is just beginning and is still in the process of development. The assumption underlying the movement is that it is better to take teach-



Courtesy, Hood Rubber Co.

Main room of the apprentice school at the Hood Rubber Co., Watertown, Mass.



Courtesy, Hood Rubber Co.

A making table in the apprentice school
The instructor on the right is showing a beginner
how to put on the outsole of a shoe



Courtesy, Hood Rubber Co.

Washing crude rubber



Courtesy, Hood Rubber Co.

Mixing mill

The durability of rubber goods depends on the grades of rubber and the ingredients used in mixing the stock

ers and put them in the factory and let them learn the making processes than to take workers and instruct them in the methods of teaching. For this reason, they have opened a training school to equip teachers to instruct beginning workers. Professor Gazell of the Department of Psychology of Yale University is supervising the work. Several persons who have made a success of teaching are now in training at the school. They have been selected from teachers, investigators, and people who have been interested in industrial work of various kinds. The method of instruction is to place the prospective teachers in the regular factory where they are doing regular work. In addition to this, a series of lectures is given from time to time by the staff, and the various problems of instruction are discussed. The object is to develop expert teachers to be sent out to their other branches to take charge of the instruction of beginners. The movement has not developed far enough as yet to show just what results may be accomplished in this way. The prospects, however, are very good, and those in charge of the work hope that it will be one means of solving the very difficult problem of securing trained workers for the manufacture of rubber goods.

Preparing Crude Rubber for Manufacturing Purposes

The principal operations, such as washing, drying, mixing, and calendering, which are involved in the preparation of crude rubber for manufacturing purposes, are practically the same whether the finished product is footwear, mechanical goods, tires, or other rubber products.

Inspecting and Grading. When a consignment of rubber reaches a factory, experts inspect and pass upon the quality of the different grades before final settlement is made. Every ball, or biscuit, is cut open and inspected

through and through. The bales of smoked or crepe rubber are torn apart so that every sheet may be carefully inspected. This is necessary in order to detect disease spots which frequently develop when crude rubber is not thoroughly dried and carefully rolled or packed before shipping. The presence of moisture in rubber is sure to impair its quality. After the rubber has been carefully inspected and graded, a tag is placed on each lot indicating the quality. This tag remains with the rubber until it is mixed with other grades in the mixing room. The operatives in this department are as follows:

Hand Truck Men. The truck men unload cars, handle bales and cases on the platform, take the rubber to and from the scales, and store the different grades in labeled bins. This is unskilled work which requires unusual physical strength. The wages range in different plants from \$3 to \$3.25 for a nine-hour day. When openings occur in the mixing and calender rooms or among floor workers in any of the departments, the most promising truck men are transferred to these positions. Injuries of any kind which impair one's physical strength would disqualify one for this work. On the other hand, deafness, partial loss of sight, or the loss of fingers need not in themselves lessen one's efficiency.

Weighers and Inspectors. This work is entirely different from that of the truck men. Physical strength is not a primary requisite but the worker must be mentally alert, possess normal sight, be able to exercise good judgment, and be accurate in keeping systematic records. The wages range from \$3.25 to \$3.50 for a nine-hour day. The work offers opportunities to industrious men for advancement to positions of foremanship and other supervising work. It is well suited to men who have lost a hand, an arm, a leg, or who are afflicted with rheumatism, partial paralysis, stiffness of neck or trunk muscles, hernia, or other physical injuries.

Washing Crude Rubber. Before rubber can be used in the manufacture of finished articles, it must be thoroughly

washed. For this purpose modern factories have washing machines, which consist of heavy iron frames supporting two large rolls revolving toward each other, either in a tank of water or with water sprayed over them from an overhead pipe. The surface of the rolls have spiral grooves imbedded in them, which grip the rubber and force it through the mill, tearing it into broken shreds and washing out all impurities, such as sand, dirt, splinters, wood fibre, pieces of bark, or other foreign materials. Rubber that is very dirty is soaked in water for several hours before it is run through the washing machine. After the rubber is thoroughly washed, it is taken to a sheeting machine which turns it out into sheets about one-half of an inch thick, and from two to three feet wide.

The Washing Machine Operator. The operator feeds the machine and sees that the rubber is kept constantly running around the rolls. After the rubber is thoroughly washed, the operator places it on trucks or carries it to the sheeting machine. Washing rubber is wet, dirty, heavy work. The wages average about \$3 for an eight-hour shift. Wide-awake men can readily qualify for other and more desirable work, such as running mixing machines, warming machines, and calenders. This operation is not desirable for handicapped men, though deafness or the loss of fingers would not interfere with efficient work.

The Sheeting Machine Operator. A sheeting machine is very similar to a washing machine, but has adjustable devices for forming the rubber into sheets. As the rubber runs through the machine, the spray of water washes it clean of all impurities. By means of the adjustable devices, the sheets are cut in various widths as desired.

Sometimes the operator of the washing machine runs the sheeting machine also. When this is done, one or the other is always running idle, hence many plants have an operator for each. Operating a sheeting machine is more desirable work than operating a washing machine, though the wages and the opportunities for advancement are the same. The work bears

the same relation to disabilities as the operation of washing does.

Drying Rubber. From the sheeting machine, the rubber goes to the dryer. The methods used in handling rubber sheets vary in the different plants and depend upon the nature of the equipment. In plants where ordinary trucks are used, the rubber sheets are usually laid out on benches about twenty-five or thirty feet long where they are cut into lengths to fit the drying trays; twelve or fifteen sheets being placed on top of one another. Where racks and elevating trucks are used, three racks, each about six feet long, are placed end to end near the sheeting machine. On these the sheets, as they are turned out, are placed and cut where the racks come together. This saves handling the rubber the second time. The following operatives are found in a typical plant:

The Sheet Cutter. This man, with a heavy steel-bladed knife, cuts the rubber into sheets from three to four feet long. The work requires medium strength and the use of one strong arm. The worker receives from \$18 to \$20 per week for an eight-hour shift. When openings for helpers occur in the batch cutting room, men may be transferred from this work to fill the position.

A man who had lost a hand or a forearm, providing he had the proper appliances, could do the work with full efficiency. Deafness, loss of one or two fingers on the left hand, partial blindness, stiffness of the neck muscles, or the loss of a leg below the knee would not interfere with good work, while, on the other hand, injuries to the trunk organs, rheumatism, paralysis, hernia, and skin diseases would be serious handicaps.

The Cutter's Helper. The helper stacks the rubber on the trucks, a task which requires him to lift the heavy rubber sheets higher than his head to put the last ones on. The pay and the opportunities for advancement are the same as those for the sheet cutters. The work requires strong arms, back, and legs, so that injuries affecting these members would disqualify one for this task. The loss of fingers, partial blindness, or deafness would not interfere with efficient work.

Truck Men. These men pull the trucks from the washing room to the dryers. The work is very heavy as the trucks are made to carry a ton or more at one time. The wages and the suitability of the work for handicaps are about the same as for the cutters' helpers.

Tray Loaders. When the rubber reaches the drying room, each sheet is placed on a separate tray. If vacuum dryers are used, the trays are put into the dryers one at a time. This is disagreeable work on account of the heat that pours out of the dryers when the door is opened. When kilns are used, the trays are loaded and placed on racks that hold from thirty-two to thirty-eight trays. The racks are made of iron and consist of a frame resting close to the floor, with two upright pieces, one set in the middle of the frame at each end, supporting several arms extending on both sides. The arms are just far enough apart to take the trays and allow plenty of space for the air to circulate among the trays. With elevating trucks, the racks are picked up and run into the kilns. This saves the worker from handling each separate tray in front of the open door of a dryer with the temperature from 160 degrees to 190 degrees Fahrenheit. The installation of kiln dryers is very expensive, but the firms that have installed them say the expense of installation is saved in about a year's time by the reduction of labor turnover and the greater efficiency of the kilns over the old system of vacuum dryers. After the rubber is thoroughly dried, it is stored in labeled bins ready to be taken to the batch cutting room.

The wages average about \$22 a week for a nine-hour day. The worker is compelled to stoop over in picking up the lowest trays and to reach up above his head in loading the highest ones. For this reason together with the high temperature of the room, the work is undesirable for handicapped men, except in case of the loss of one eye or deafness.

Batch Cutting. There are many grades of rubber on the market, and seldom is one grade used entirely in the manufacture of any class of goods. The usual method is to mix the different grades in varying proportions according to the use

that is to be made of the finished product. It is to be noted, however, that only the best grades can be used for making rubber cement. The quality of the factory rubber depends upon the proportion of the different grades of which it is composed. Experts in the laboratory make out written statements indicating in pounds the amount of each grade to be put into a certain batch. These statements are sent to the batch cutters who carry out the instructions with great care. The following are the operatives usually found in this department:

Batch Cutters. These men make up the batches according to the orders received from the foremen. Each cutter is supplied with scales which weigh to a fraction of an ounce, and he must cut the rubber to exact weight. The work can be learned in a few days without previous experience, although the best cutters are men with a number of years' experience. Proficient work requires a trained eye, quick judgment, and a deft use of the knife which has a special steel blade about fourteen inches long. The wages range from \$3 to \$3.25 for a nine-hour day. While the worker is obliged to move about constantly, there is very little stooping or heavy lifting, hence the work offers good opportunities to disabled men who have lost one eye, a leg, or who have received wounds that have caused stiffness of the neck or trunk muscles.

Helpers. Each cutter has a helper who assists in handling the different grades of rubber and in other parts of the work as directed. They receive from \$2.50 to \$3 for a nine-hour day, and are in line to become cutters when the opportunity offers. On the whole, the work bears the same relation to disabilities as that of the cutter, although the helper must do more lifting than the former does.

Inspectors. An inspector moves about among the cutters constantly in order to see that the weighing is properly done. Inspecting is pleasant work and well-adapted to men with serious physical handicaps. The wages range from \$3 to \$3.25 for a nine-hour day, and chances for promotion to supervising or executive positions are very good.

Handling Rubber Compounds. Not only are different grades of rubber mixed together in preparing rubber for manufactur-

ing purposes, but other materials are compounded with the rubber. Some of the materials like sulphur and white lead, improve the serviceable quality of the rubber, while others, such as whiting and lime, are added to lessen the cost of the articles produced. If compounds were not used, all rubber goods would be either unserviceable or prohibitive in price. For instance, one manufacturer says: "Pure rubber for jar rings, with only a minimum of profit, would at the normal cost of rubber, have to sell at one dollar and fifty cents per pound, yet would seal fruit jars no better than those now sold at thirty cents. Pure rubber belting would cost a fortune, but would not transmit power so ably or so long as the belts now made of the heavy cotton ducks and *rubber compounds*, which study and experience have developed for present day use. The question in most cases is purely one of service, the exact mixtures in manufacture being the result of long and careful research." The following are the compounds most commonly used: Sulphur, whiting, zinc, aluminite, litharge, white lead, lime, red oxide, lamp blacking, mica and talc. The secrets of rubber manufacture lie largely in the various combinations of the compounds. Chemists are continually discovering new mixtures that improve rubber goods and lessen the cost of production.

The work in the compound room is light and may be called semi-skilled. It takes a beginner from a week to two weeks to become handy and a longer time to become a first-class worker. The most important work is weighing the different materials, which, for the making of tires, must be weighed accurately to a fraction of an ounce.

The dust from the different materials is disagreeable and presents certain health hazards, especially to persons inclined to lung and throat trouble. Otherwise the opportunities are good for men who have lost one leg, part of a hand, one eye, or who have defective hearing. The wages range from \$3 to \$3.50 for an eight-hour day.

Mixing Rubber Stock. Mixing rubber is similar to kneading bread. Various materials, such as lard and yeast are mixed with flour to make dough that will bake without becoming

tough and hard. So likewise different materials, such as sulphur and white lead, are mixed with rubber to produce a compound that will remain soft and pliable after it has been baked or vulcanized.

Gum elastic shoes, such as those sold in Boston in the early twenties of the nineteenth century bear the same relation to the rubber shoes of today as unleavened bread bears to the prize loaves of a modern bakery. The analogy can be carried further, for just as success in making bread depends upon the thoroughness with which the dough is kneaded, so the success in the manufacture of rubber goods depends upon the thoroughness with which the ingredients and rubber are mixed together.

For the purpose of mixing rubber, gigantic machines are used. These machines consist of a heavy steel frame set in a base of concrete, and holding two immense cylinders or rolls which revolve toward each other. The rolls have polished surfaces and are adjustable so that they can be set to turn out rubber sheets varying in size from one-half inch to an inch and one-half in thickness.

Underneath the rolls is a large pan into which the different grades of rubber are thrown. The rolls are geared to run at different speeds, and as the rubber is fed to the machine, it gathers around the one which runs the slower. Usually it forms a sheet around the cylinder from one-half inch to three-quarters of an inch in thickness. The operator, with a sharp knife, cuts the sheet frequently, catches the rubber as it rolls off the cylinder, and throws it back into the machine. This process is continued until the different grades of rubber are thoroughly mixed together. The compounding ingredients are thrown in and thoroughly mixed with the rubber. The rolls are then adjusted so as to press the stock into a continuous sheet of rubber of the desired thickness. Helpers cut the stock into lengths of four or five feet and place it on trucks by which it is transferred to the calender room. As the rubber is laid on the trucks, pieces of cloth are placed between the sheets to keep them from sticking together.

Wages range from \$3.50 to \$3.85 for an eight-hour shift. A foreman in a large plant makes the following statement concerning the suitability of the work to handicapped men: "A man with an artificial leg could do any of the work in the mixing room. Even a man with two artificial legs could do the weighing of the rubber and help in other ways. While the worker must have two hands, the loss of three fingers or less would not interfere with efficient work. Workers are obliged to do a great deal of stooping so that injuries to the trunk organs would be serious handicaps. Good eyesight is necessary, and the continual noise in the room would be too much for one affected with shell shock."

Calendering Rubber. The material goes from the mixing room to the calender room. The first process is that known as cracking the rubber. For this large machines are used. The purpose is to break up the hard rubber and press it into sheets ready for the warming machines. The work of warming the rubber is done on machines very similar to mixing machines but with steam pipe attachments by means of which the rolls are heated. The object is to soften the rubber before it goes to the calenders.

Operating Cracking and Warming Machines. This is very heavy work, the operator handling as much as three or four tons of rubber in one day. On this account, the work is undesirable for handicapped men. Wages average about \$18 per week for an eight-hour day, and wide-awake men are promoted to calenders as opportunities open.

Calender Operators. Calenders are large machines having three or more rolls supported in a heavy frame. The driving gears are adjustable so that the rolls can be driven either at equal or unequal speeds as the nature of the work requires. The rolls may also be adjusted so as to turn out sheets as thin as tissue paper or a half-inch or more in thickness.

One kind of calender turns out thin sheets used for the upper part of shoes and boots; another kind forms thicker sheets used for soles and heels; and still another kind coats layers of gum on fabrics used for linings, stays, and various pieces used for reinforcing different parts of the shoe. Operat-

ing a calender is semi-skilled work and the position is usually filled by men who have been working on cracking or warming machines. An average man will learn to do good work in a few months, but it requires six months or more for one to become proficient. The wages average about \$24.50 a week for a nine-hour day. The work is much lighter than that of washing and mixing rubber and offers favorable opportunities for men whose injuries unfit them for hard physical labor. Men with artificial legs are doing this work in some plants with perfect satisfaction.

A calender operator has from two to five helpers, according to the type of the machine and the nature of the work that is being done. Those who show themselves competent as helpers are in a position to be promoted as operators of a calender. Wages range from \$19 to \$20 per week for a nine-hour day. The work is quite varied and men who have lost fingers, especially of the left hand, or a leg below the knee would be able to do efficient work.

Reclaiming Old Rubber

The reclaiming department takes automobile tires, boots, shoes and other old rubber articles and works them over into a low grade of rubber, known as shoddy. The various processes are as follows:

Sorting. The old tires are sorted according to quality and color. The quality depends upon how much the tire has been used and whether it has been over oxidized or not. The worker must use his judgment in sorting the tires as to their quality. As to color, tires are sorted into those that will make white, gray or black shoddy. The worker cannot tell by looking at the tires which color of shoddy they will make, but must depend upon the name of the manufacturer. The laboratory of the reclaiming department has analyzed the tires of the various manufacturers and has determined the ingredients used by each maker. The color of shoddy depends upon the ingredients used. Of course, manufacturers change their

formulas from time to time so the laboratory department has to be on the lookout for this.

It usually takes a man about three months to become a good sorter and a longer time to be able to earn the highest wages. Wages range from \$20 to \$21 per week for an experienced man, while helpers receive about \$19. The work is usually done out of doors and is therefore suitable for men with weak lungs. Most foremen are of the opinion that a man with one arm, one leg, a stump of a hand, or hernia could do satisfactory work. Wide-awake men have splendid opportunities for advancement to positions which pay better wages.

Cutting Off Beads. The beads of tires are cut off by machines. The operator holds the tire on a platform which revolves under a knife. The work is not hard, but requires the use of two good hands and one must move about considerably in handling the tires and holding them on the machine. On this account the work is not suited to men with handicaps, although the loss of one or two fingers or defective hearing would not interfere with efficient work. Wages average about \$25 per week and the opportunities for advancement are good.

Stripping Beads. This work consists in stripping the fabric and rubber off the metal bead. It is heavy work and very disagreeable on account of the fact that the beads must be soaked in water and stripped while wet. The operator receives about \$28 per week for a nine-hour day.

Weighing. Weighing the tires is light work which could be done satisfactorily by one who had lost a leg, an arm below the elbow, or who had trunk injuries or hernia in a light form. The work requires mental alertness and offers splendid opportunities for advancement. Wages range from \$20 to \$22 per week. The average man would learn to do this work well in about two weeks.

Cracking and Grinding. After the tires have been weighed and washed they are taken to a cracking machine which breaks the rubber into large pieces. These pieces are then shoveled into another machine which grinds them into small particles. Underneath the rolls of the grinding machine is a pan from which an upright conveyor carries the material to

a hopper, ten or twelve feet above the floor. The bottom of the hopper is covered with a quarter-inch mesh screen and all the pieces which are too large to pass through the screen go back to the grinder. The operation is continued until all the material is ground fine enough to pass through the screen. Horizontal conveyors carry the fine product to an apparatus called a riffler, which consists of a long trough into which a stream of water constantly pours and carries the material along. Gravity is by this means used to segregate the foreign substances. As the material is washed along the riffler the heaviest parts settle to the bottom and only the lightest material is carried on to the farther end of the trough.

One operator with three or four helpers takes care of the cracking, grinding, and riffing of the rubber. The operator receives about \$22 per week and the helpers receive \$21. The work of handling the rubber as it goes through these machines is very heavy, some of it being done with large shovels, which require strong arms and strong back muscles. There is a considerable amount of walking back and forth so that on the whole the work is not suited to men with serious handicaps. The loss of one or two fingers or defective hearing would not interfere with satisfactory work. It takes about a week's time for a man to learn to operate a machine; helpers could start in immediately.

De-Vulcanizing and De-Fiberizing. The material as it comes from the riffler is collected into tanks where it is reduced to a pulp by means of chemicals and heat. Caring for the chemical tanks or de-vulcanizers, as they are sometimes called, requires a considerable amount of walking and because of the extreme heat is not suited to handicapped men. Most plants employ Americans for this work. Wages range from \$20 to \$22 per week. A man will learn the operation in about three weeks' time. The position offers good opportunities for advancement to minor executive positions and foremanship. From the de-vulcanizer the material goes to the presses. The presses are long and tapering, being 200 feet in diameter at one end and gradually sloping to a diameter of 100 feet at the other end. The frame is made

of slots with small crevices between them through which the liquid passes as the material is forced through the press. Pipes are arranged to convey the liquid into evaporating tanks. The dry material is taken directly to the drier. Wages for this work average about \$22 a week. The work could be done no doubt by one who has lost a leg below the knee, provided he had a suitable appliance. The loss of two or three fingers would not handicap one.

Drying. The pulp is dried by an apparatus which consists of a blower surrounded by steam pipes. The blower forces hot air through the material and dries it thoroughly within a few minutes' time. After the material has been dried it is stored in long shallow bins or pans, arranged so that there is a vacant space beneath them of about two feet. Steam pipes extend through this space beneath the pans and keep the material perfectly dry until it is to be used. Caring for the drier requires one to climb up ladders, walk back and forth through a room about fifty feet long, and handle the material with shovels, which require the use of both hands. The work is not therefore suited to men with serious handicaps. Wages average \$22 a week.

Straining. Before the rubber is taken to the refiner and worked into rolls for manufacturing purposes it is passed through a straining machine which removes all foreign particles, such as splinters and pieces of metal. The strainer is made on the principle of a sausage grinder; the material is fed into the hopper leading to a revolving auger, which forces the material through a fine screen which removes foreign substances. Operating the strainer is light work and could be done by one who had lost a leg or who had trunk injuries, defective hearing, or hernia in a light form. Wages average about \$22 per week.

Refining. From the strainer the material goes to a refiner, which is very similar to a calender, although, as a rule, one of the rolls is much larger than the other one. The object is to turn out the rubber in very thin sheets so that if any foreign particles should have passed through the strainer they would be thoroughly crushed by the refiner. As the sheets come from

the refiner they are folded together forming, what appears to be a solid roll of shoddy about six inches in diameter and three feet long. This completes the reclaiming processes and the rubber is ready to go to the batch cutting room and to be mixed with other grades of rubber for manufacturing purposes. This work pays about \$22 a week. In one plant, at the present time, a man who has lost an arm is doing highly satisfactory work. The work is light and could be done without doubt by one who had lost a leg below the knee, or who had trunk injuries, defective hearing, or hernia.

Preparing Cloth for Calenders and Spreaders

In the manufacture of footwear, automobile tires, and many other rubber goods, a large amount of cloth is required. Different qualities of cloth are used for the different articles, ranging all the way from light cheese-cloth to very heavy duck. The following are the principal operations involved in preparing it for calenders and spreaders:

Weighing, Winding, and Measuring Cloth. The cloth comes to the factory, as a rule, in immense cases weighing from 600 to 800 pounds each. These are handled by hand trucks and placed in the cloth room. Here the iron hoops are cut off and the cases unpacked. The next operation in connection with the cloth is to weigh, measure, and wind it into 300 or 400-yard lengths. This work is done on a simple machine consisting of a platform about ten feet long on which is mounted a frame carrying, as a rule, four rollers. As the cloth is about a yard and a half in width, the rollers must be about six feet long. The process consists in running the cloth around these rolls and over a measuring drum to the winding reel. The object in having a number of rolls is to smooth out and stretch the cloth tight before it passes over the measuring drum. After the cloth has been wound tightly on the winding reel, it is taken to the dryer. The work of weighing and measuring cloth is comparatively light with the exception of the handling of the

rolls. Where an operator and two helpers work together, one of them would be able to do efficient work if he had lost a leg below the knee, a part of his hand, or perhaps an arm below the elbow. At least two of the men must be able-bodied in order to handle the heavy rolls. Operators receive \$21 a week and helpers \$18.50. The opportunities for advancement to calender work are good.

Burling. Cloth that is used in the manufacture of fine goods must be entirely free from knots and loose threads. The work of picking out the knots and loose threads is done by women, and is known as burling. Every inch of the cloth must be inspected by them. The work is done at a table while the operator is seated. Most foremen feel that women are better adapted to this work than men, though it is sometimes done by the latter. All of the heavy work now is done by floor-men so that if handicapped men were employed, no change would need to be made in the usual routine of work. Women receive from \$14 to \$16 per week on piece-work.

Drying Cloth. After the cloth has been measured, it is taken to the drying machines. For this purpose, most plants have two styles of dryers: A can dryer, constructed to turn out a very large quantity of work on all kinds of fabrics, from net fleeces to heavy ducks; and a cell dryer used mostly for the heaviest goods.

The can dryer is a rather complicated machine from the point of view of structure but simple in operation. The principal part of the machine consists of a heavy steel frame supporting six large cans two feet in diameter and five or six feet in length. The six cans are arranged three on one side and three on the other side of the frame. The cloth is placed on a bench near the machine and runs around the first roller on one side of the machine and then around the first one on the opposite side, and so on around all of the cans. From the last can, the cloth goes over a roller at the top of the frame and then down to another roller near the floor and, from this roller, over a measuring drum and then out to a winding reel. The large cans are heated by steam so that the cloth is thoroughly dried. From the dryer, the cloth goes either immediately to

the calender room or to a store room kept free from moisture by artificial heat. As a rule, one operator and a helper run the can dryer. The loss of one or two fingers or defective hearing would not interfere with good work. A one-armed man would be able to do satisfactory work as an operator providing the helper was able-bodied. While there is not much dust connected with the work, there is, undoubtedly, enough to make it impossible for one with weak lungs to do work with safety. Operators receive from \$19.50 to \$21 per week, while helpers receive from \$18.50 to \$21. Opportunities for advancement to the calender room are good.

The cell dryer is simple in construction, consisting of a heavy steel frame supporting four cells about five feet wide and six or eight feet long and seven or eight inches deep. The cells are made of cast iron and are hollow so that they can be filled with steam. The cloth runs around them in practically the same way as around the cans on the other dryer and is conducted from the cells to a measuring drum which records the yardage. From here it is wound on a roll ready to be taken to the calender room. As mentioned above, this style of dryer is better adapted to heavy than to light cloth. The work of operating it is similar to that of the can dryer, and wages and opportunities for advancement are the same.

Cutting Rubber Stock for Footwear

After the material has been prepared as described above, it goes to the cutting room where the various parts are cut out. The principal operatives in the footwear cutting department are as follows: (1) Stock Receivers, (2) Stock Carriers, (3) Cementers, (4) Die Cutters, (5) Gum Coverers, (6) Upper Cutters, (7) Outsole Cutters, (8) Outsole Cutting Machine Operators, (9) Back Hand Cutters, (10) Parsons Press Operators, (11) Clicking Machine Operators, (12) Seelye Machine Operators, (13) Electric Machine Operators, (14) Laying Forms, Rolling and Booking Operatives.

1. *Stock Receivers.* As the rubber comes from the calenders, it is transferred on long canvas belts directly to the cutting department, where it is received on reels or placed on frames about ten feet long. Plain rubber sheeting is easily handled on reels, but sheeting on which forms have been imprinted must be handled without being rolled. Receiving the rubber sheeting on reels is the lightest kind of work and is usually done by women. It could easily be done by men with an artificial leg, a stump of an arm, trunk injuries, heart diseases, or hernia. The work of handling frames is light and suitable for men who have lost a hand, a forearm, a leg below the knee, or who have received other injuries which make it impossible for them to do hard work. The wages range from \$20 to \$22 per week and the workers are in line to be advanced as cutters or machine operators.

2. *Stock Carriers.* Stock for the upper part of a shoe is received either on frames or on reels; stock for soles is placed on boards about two feet wide and three feet long with cloth in between the rubber pieces to keep them from sticking together. In this way, twelve or fifteen sheets are carried on one board, or book as it is called, while only one layer of rubber is carried on a frame. The books, frames, and reels are transferred to the cutting tables either by trucks or by hand. Although the work is not very heavy, it is not suitable for wounded men except in cases of finger amputations, deafness, or partial loss of sight. Wages range from \$20 to \$22 per week, and the men are in line to be advanced to better positions as they are needed.

3. *Cementers.* The various parts of the rubber shoe are cemented rather than sewed together. This requires that each piece be either cemented over its entire surface or along the margin. Most of the work is done by hand but some plants have installed machines for cementing inner soles. The work of cementing is done on tables and is not heavy but requires a considerable amount of walking about. Wages range from \$16 to \$20 per week. Now and then some workers make as high as \$30 by piece-work. Women and boys are doing most of this work at the present time. There seems no reason,

however, why men with artificial legs, weak lungs, heart disease, trunk injuries, rheumatism, or hernia might not be employed at this work satisfactorily.

4. *Die Cutters.* Many of the smaller parts for footwear are cut by hand dies. The men who do this work are known as die cutters. They have dies with handles attached which enable them to set the die with one hand and strike a blow with a mallet with the other hand. Experienced men are able to turn out work very rapidly. Using a small die is light but tedious work while operating a large die is very heavy work. The operator must not only stand all day long, but must move about to get his stock and to place the parts in the book after they have been cut. Whether or not the work would be suited to men with various handicaps would depend very largely upon the attitude of the man. A person who could stand all day long on an artificial limb would find the work very satisfactory. The wages range from \$25 to \$30 a week.

5. *Gum Coverers.* This is a process in which the parts which have been cut from fabric are laid on rubber sheets and the rubber parts are cut with a knife to match the fabric parts. The work is very similar to upper-cutting, though not quite so heavy. Women work at this operation in many plants at the present time though men are still employed in large numbers. The wages range from \$25 to \$30 per week on piece-work. Men who have lost a leg or who have weak lungs, heart disease, or defective hearing could do this work without much difficulty. It takes about three weeks for the average person to become handy at this operation and a much longer time for him to become competent to earn the highest wages.

6. *Upper Cutters.* Most calenders used for turning out stock for the upper parts of shoes have prints on the surface of the rolls which mark the patterns which the cutter follows in cutting the stock. This enables the worker to use a knife instead of a die. The work is not heavy but brings into action practically every muscle in the body, as a man must be able to cut patterns of many different forms. Besides the motions

necessary in cutting the stock, the operator must step to one side of the cutting table to obtain the rubber and turn around to place the parts in books. Though the work is not hard, it involves so many different motions that it would be very difficult for a man with handicaps of any kind to do efficient work, though a man who had lost a leg below the knee might do satisfactory work. Again, it must be said that, while this is true in general, men differ so widely in their ability to overcome handicaps that the most one can say is that this operation is unsuited to disabled men except in cases of unusual adaptability. Wages are paid by piece-work. Proficient cutters often make as high as \$35 or \$40 per week. As this is one of the best paying operations in connection with the manufacture of shoes, there is very little opportunity for advancement.

7. *Outsole Cutters.* Outsole cutting is heavier work than cutting the upper parts of shoes. The operator uses a back-hand stroke and, at the same time, must learn to cut the edge on a bevel. The operation involves about the same motions as that of upper-cutting and bears practically the same relation to handicaps. Wages are paid by piece-work, and men average from \$30 to \$35 per week.

8. *Outsole Cutting Machine Operators.* Outsole cutting machines are used in many factories to do the work of cutting the heaviest soles. It is a very simple machine with a knife arranged to revolve so as to trace the form of the sole. It can be adjusted to cut small or large patterns. The operator controls the machine with a tread and moves the rubber sheeting along the table under the knife as the machine is in operation. It takes about six weeks for a man to become expert at handling the machine. Wages average from \$25 to \$30 per week on piece-work. Men who had lost a leg, one or two fingers, or who had received slight physical injuries to the trunk organs would be able to do the work with very little loss of efficiency.

9. *Back Hand Cutters.* Patterns for samples and odd jobs are cut by hand as the price of making dies would be prohibitive. Back-hand cutters are also called upon to do work when machines have to be repaired. The operator grips the

knife in the palm of his hand and makes a backward stroke in cutting out the pattern. Well-trained men can cut from twelve to fifteen plies at one time. While the stroke is the same as that used by the outsole cutters, the cutting must be done straight and not on the bevel as is the case with the outsole work. This operation varies greatly in the different shops and in the same shop at different times, which makes its nature more or less seasonal. During steady work, operators will average \$20 to \$25 per week on piece-work. While the work could probably be done by men who had lost a leg or who had received slight physical injuries to the fingers or left arm, it is, as a whole, undesirable for handicapped men.

10. Parsons Press Operators. Cutting rubberized fabric is usually done on machines. For this work, there are a few standard types, such as the Parsons, the clicking, and the Seelye machine. The Parsons machine is the strongest and is made to do the heaviest kind of work. It consists of two heavy wrought iron legs supporting a press table and a huge beam hammer which is connected by four very large rams with an eccentric drive. The driving shaft is connected with a friction clutch which is joined with a brake in such a way that when the clutch is free the brake is set. The brake holds the hammer up while the operator sets the die. The clutch is thrown in place by means of a foot tread. The machines are made in several sizes with the hammers running from four to six feet in length. The operator handles the die with both hands but would, no doubt, be able to do satisfactory work with a loss of one or two fingers, provided he had the first finger on each hand. The work is not hard but there are hazardous features about it that make it necessary that the operator have sound physical health and good mental poise. Should he trip the machine while setting the die, he might lose both hands or even both arms. From fifteen to thirty plies of fabric are cut at one stroke which indicates something of its tremendous power. It usually takes about six months for one to become skilled in operating this machine. Wages by piece-work range from \$35 to \$40 per week. Each operator has a helper who receives from \$15 to \$16 per week, and is in line to become an

operator of the clicking or Seelye Machine. Men with a part of a hand, a stump of an arm, or an artificial leg could do efficient work as helpers.

11. Clicking Machine Operators. The clicking machines are adapted to cutting toe tips, juniors, or counters, fillers and other small parts of the shoe. It consists of a cutting board or block over which a strong arm or beam about three feet long swings from side to side. The arm is attached to an eccentric drive by a large spindle about eight inches in diameter. The operator of the machine sets the die upon the fabric just as a hand worker would place a pattern upon it then swings the arm of the machine over the die and trips the machine with the same hand by which he swings the arm of the machine over the die. After the arm hits the die it returns automatically into place. There is very little danger involved in operating this machine, and the average man can learn to run it in about two months, though it takes a longer time for him to become an efficient worker. The operator has no helper and must count and mark the parts as he cuts them. Wages average from \$30 to \$35 per week by piece-work. Many foremen are of the opinion that though the work requires the operator to stand continually that it could be done by one who had an artificial leg or ankylosis of the knee or hip joint. Men who have defective hearing or who have lost two or three fingers except the first finger would be able to do satisfactory work.

12. Seelye Machine Operators. The Seelye machine is built on the principle of the Parsons press machine but is not so strong. It is, however, adapted to doing heavy work with less waste of material. The operator does his own counting and marking and is paid by piece-work. The rate, as is the case with the other machines also, varies with the proportion of waste stock left at the close of the day. The work bears about the same relation to handicaps as that of the clicking machine. It takes from two to three months to learn to do good work and a longer time to become master of the machine.

13. Electric Machine Operators. Many shops have introduced electric hand machines to cut large patterns from rubberized fabric. The work consists in marking out the

patterns and operating the machine. In some plants two men work together. Both are experts and take turns at marking and operating the machine. They are paid by piece-work and often make \$30 to \$40 per week. Sometimes the machine operators lay out their own stock, but usually helpers do this work. Laying out stock is an operation which is well adapted to men who have received injuries that unfit them for hard physical work. The wages range from \$15 to \$20 per week, and the men are in line to be promoted to more desirable positions as opportunities offer.

14. Laying Forms, Rolling and Booking Operatives. Many parts of rubber footwear are made double; one part being made of fabric and one of rubber. Laying forms consists in taking the similar parts of fabric and rubber and placing them together. In some plants girls do this work while in others boys do it. Girls receive from \$12 to \$15 per week while boys make as high as \$20 or more.

After the forms have been laid, they are taken to the rollers where they are run through a press consisting of two rollers arranged on the principle of a common clothes-wringer. This is to remove all wrinkles and air pockets and to press the rubber and fabric together. The operation requires two persons, one to feed the machine and one to receive the parts and place them in a book again. The work is light but requires quick movements and continual standing. Men with weak lungs, heart disease, or defective hearing would find this work very satisfactory.

From the rollers, the patterns go to a room where girls make up books. This work consists in taking the number of each part which one worker will use during a day and placing them in books ready to go to the making tables. At the present time girls are employed at this operation. Wages average about \$15 a week. The only thing that would debar men with serious handicaps from this operation is the low wages. The average person can learn to do this work in about one week's time.

Making Rubber Shoes

Rubber shoes are, for the most part, made by hand. The various parts are put together with cement instead of stitching as is the case in leather shoe making. The principal operations are as follows:

Lasting. The first operation in the making of a shoe is known as lasting. Taking a last, the operator first covers it with what is known as the shoe lining. After this has been stretched smoothly over the last and the edges folded over the bottom, the inner sole is put in place. On the best quality of shoes, a strip of rubber three-quarters of an inch in width is run around the edge of the sole. With a gauge, the laster marks the shoe for the upperer and then cements on the junior or counter as it is called in shoe manufacture; the heel piece; the filler; and the toe piece. With a rubber roller, the different parts are rolled out smooth and the seams pressed down tight. The work is usually done by women who earn, by piece-work, from \$15 to \$20 per week. This operation would offer suitable employment to men who have injuries affecting the lower extremities. Most manufacturers, now, however, prefer women for this work.

Uppering. Beginning where the laster left off, the upperer first places the vamp (*i. e.*, the part which forms the instep of the shoe) in place as marked by the laster and folds the edges over the top of the sole and joins the ends together to form the heel seam. The shoe is then carefully wiped with a cloth and rolled smooth with a rubber roller. The rubber junior is then put over the heel and a seam is run around the edges of the junior and the sole to give the shoe a finished appearance. The shoe now goes to the outsoler. The nature of the work and the wages paid are the same as in lasting.

Outsoling. The first operation of the outsoler is to cement the soles and place them on the shoes to dry. After they have had time to dry properly, they are rolled down with a heavy roller. Outsoling is particular work as it gives the final appearance to the shoe. In most plants men do this work and the wages average about \$25 per week on piece-work. The work

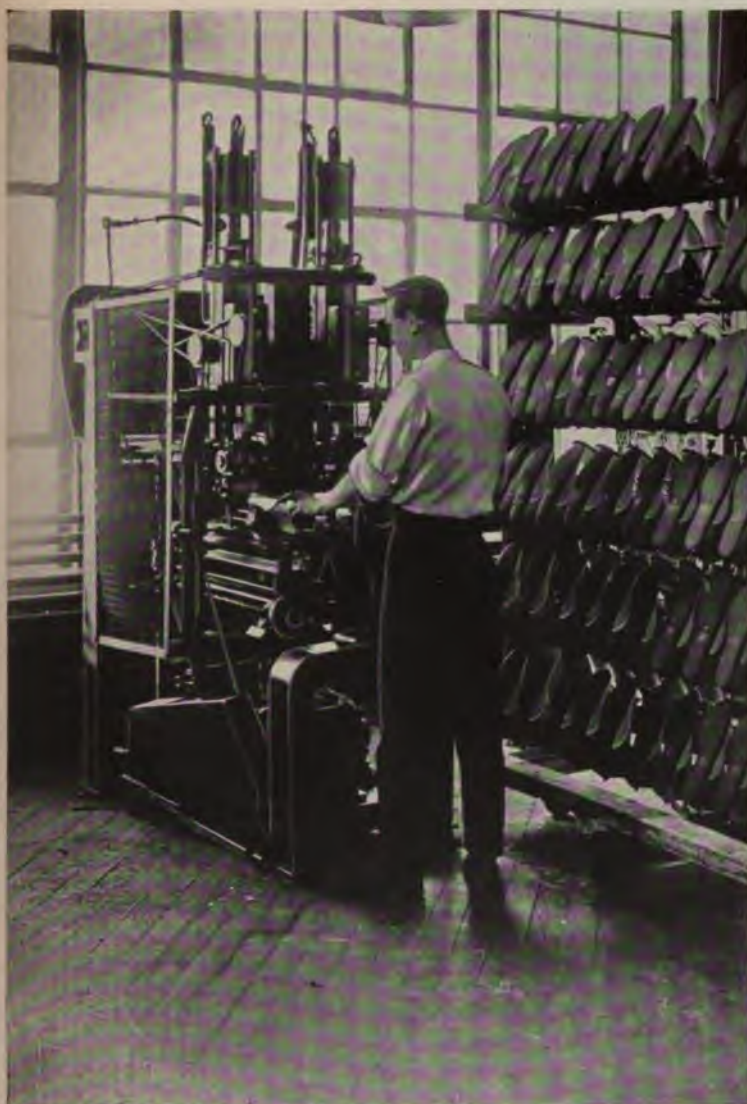
requires the full use of the arms and hands, and, on the whole, is not well suited to handicapped men except cases of deafness and slight injuries to the lower extremities.

Checking. Rubbers go from the outsoler to the checkers. These persons, usually girls and boys, check all the shoes and credit to each worker, by number, the exact number of shoes of each kind made by the worker during the day. The workers' pay is determined by this record. Should any of the shoes be damaged after they pass the checker, the worker would receive full pay regardless of what damage had been done.

Two persons work together at checking the shoes; one counts the shoes and the other one checks the counts on checking forms. The work of counting the shoes involves a good deal of walking about, but, as the shoes are handled one at a time, no heavy lifting is necessary. At the present time, most plants employ boys for this work. There is no reason why men with serious handicaps, such as trunk injuries, heart disease, the loss of one leg, the loss of an arm, hernia, paralysis, or weak lungs could not do the work with satisfaction. The work of checking is done at a table while the person is seated. Girls are usually employed at this work and the only thing that would debar handicapped men who were able to write well would be the low wages paid. Girls receive from \$12 to \$15 a week for a nine-hour day.

Varnishing. Before the shoes are vulcanized, they are varnished with a preparation which gives them the appearance of patent leather and renders them capable of withstanding great changes of temperature without cracking. Shoes with cloth tops are varnished by hand while whole rubber shoes are dipped in the varnish. Hand varnishers make, by piece work, from \$32 to \$33 a week while operators of dipping machines make as high as \$35 to \$40 per week. The work involves a considerable amount of moving around as well as lifting bars with from six to twelve shoes at a time. It is, therefore, not suited to men with other handicaps than the loss of one or two fingers or defective hearing.

Vulcanizing. After the shoes have been varnished, they are taken to the vulcanizers in lots technically called heats. Each



Courtesy, Hood Rubber Co.

Automatic rolling machine

One man can roll several thousand shoes in a day

heat contains from six to eight cars and each car contains from eighty to two hundred pairs of shoes. Vulcanizing rubbers is a very particular piece of work. The foreman in the laboratory makes out a curing schedule for each lot of shoes. Heat is applied by means of steam pipes which extend underneath the floor and sometimes around the sides of the room. A thermometer is placed at each corner of the room and the man in charge must see that the heat is distributed evenly throughout the room. For the best results the temperature must increase gradually until it reaches about 260 degrees Fahrenheit. Different shoes are left in the curing room different lengths of time, but it takes four to eight hours for the shoe to cure well. The work is heavy and requires able-bodied men with more than ordinary physical strength. Wages range from \$27 to \$30 per week for a nine-hour day.

Making Rubber Boots

The work of making rubber boots is very similar to that of making shoes but it is heavier and involves more operations. Some plants follow two methods in making boots, the old or individual method in which one person makes the entire boot, and the new or team method in which a number of men work together, each doing a certain part and passing the boot on to others who do their parts in turn. The following are the principal operations involved in making boots by the team method:

Lasting. As mentioned above, in most plants the work of making boots is done by a group of men working together. The first operator does what is known as lasting. The work includes the following: Putting on leg lining, inserting inner sole, strapping up the leg lining, placing on the toe lining, putting on the rag sole, the cloth heel stay, the rubber heel stay, the cloth front stay, the rubber front stay, the inner vamp, the ankle piece, and the knobs.

Legging. The laster then cements the boot and places it on a truck to be taken to a parking place or passes it directly to

the next operator who performs the work known as legging. It consists of putting on the rag counter, the leg cover, stitching the seams, and stamping on the label and the worker's number.

Stamping. The boot goes from the legger to the vamer who performs the following operations: Putting on the rubber counter, inserting the outer filler, placing on the vamp, the toe tugging, the back strap, stitching the sides and back of the vamp, and stamping on the worker's number.

Outsoling. From the vamer the boot goes to the outsoler who cements the boot for the outsole, puts on the outsole, puts on the toe strips, and puts on the binding.

Putting on the Top. Outsoling finishes the low top boot, but storm, sporting, and hip boots go to another worker who performs the following operations: Cements on the top, puts on the boot chafing strips, rolls and stitches the seam, and dusts the top with a cloth.

Low top boots reach about to the knee; storm boots to a little above the knee; sporting boots well up on the hip; and hip boots reach up to the belt to which they are strapped.

Handling the boots during the process of manufacture is hard work, but does not involve any heavy lifting. The work is done while the operator stands and is not suited to men with serious handicaps, though one who has lost one or two fingers, has defective hearing or a light form of hernia could do the work with satisfaction. Some foremen say that men with an artificial leg could be used to good advantage. This, however, depends upon the attitude of the person himself. Wages range from \$30 to \$35 a week for a nine-hour day. It is the most popular operation among the men, and floor men, truck loaders, and last strippers are all anxious to become boot makers. The average man can learn to do the work in one to six weeks, but it takes longer for him to become competent to earn the highest wages.

Individual Boot Making. Where one man makes the entire boot the work is better adapted to handicapped men. Individual workers often sit at the table while performing the various operations and, as a rule, do not have to move about so much to obtain the material. In some plants men who are

not able, on account of age, to keep up the speed in team work are allowed to do individual work. Men who have lost a leg or who have heart disease, defective hearing, or hernia could do efficient work at this operation. It takes six months or more for the average man to become a good boot maker.

Making Arctics, Gaiters, and Lumberman's Shoes

The making of arctics, gaiters, and lumberman's shoes is classed as heavy goods work and usually associated with boot making.

ARCTICS

The work of uppering and lasting is very similar to the same operations in gum shoe manufacture. Arctics are made in light and heavy weights and with cloth or rubber tops. The principal operations involved in making arctics are as follows: Assembling tops, lasting, and outsoling.

Assembling Tops. The tops or quarters, as they are called, are assembled in a room separate from the making room. The forms are laid out on a table and a strip known as the pocket is cemented around the edges; the buckles, or ladders and take-ups, as they are called, have rubber tabs attached to them. The ladders and take-ups are set in place by the help of a stencil gauge and a strip of piping is cemented over the tabs. The piping is rolled down with a heavy rubber roller, and the quarters are ready to go to the making department.

Lasting. The laster usually does the work done by both the laster and upperer in connection with shoe making. The work consists in putting in place the lining, the insole, the shank, the junior, the toe tip, the piping, the vamp, the quarters, the fillers, and the foxing. Men, as a rule, do this work and receive from \$25 to \$30 a week on piece-work. One can pick up the work in a few days but it takes about two months to be able to make the highest wages. The work requires able-bodied men, though one who had lost one or two

fingers or who had defective hearing or ankylosis of the knee or ankle might be able to do the work without much loss of efficiency.

Outsoling. Outsoling is almost identical with that of making light rubbers, with the exception that it is heavier work. Men often make as high as \$35 on piece-work after they have been working for several months. The work could be done by one who had lost a leg below the knee providing he had a suitable artificial limb. The loss of one or two fingers or defective hearing would not interfere with satisfactory work.

GAITERS

Gaiters are very similar to arctics; shoes with one buckle only are called arctics while those with two or more buckles are called gaiters. Gaiters range from the low two-buckle to the high six-buckle shoes. Some women's gaiters are made with buttons rather than buckles and some men's shoes are made with eyelets instead of buckles. Lace shoes range from four to eight eyelets. The work involves the same operations, pays about the same wages, and bears the same relation to handicaps as that of making arctics.

LUMBERMAN'S SHOES

Lumberman's are a very heavy shoe, about midway between gaiters and rubber boots. Some are made with cloth tops and some are made with rubber tops fleece-lined. The cloth tops are assembled in the same way as those of arctics, and the operations are about the same, though, in some styles, a number of additional parts are added to give strength and service to the shoe. The nature of the work is similar to that of making arctics and bears about the same relation to disabilities. In many plants, the operator makes the entire shoe, and, where this is done, men with injuries to the lower extremities would be able to do the work without the loss of

efficiency. Men who are experienced average from \$30 to \$35 at individual work.

Making Tennis Shoes

A great many different kinds of canvas shoes are being made today under the general name of tennis shoes. They range all the way from the hospital slipper and the pump to the men's work shoe and the women's fancy high top shoe with twelve or more eyelets. In some plants, lasting machines and welt stitching machines have been installed. The typical operations are discussed in the following sections:

Stitching. The canvas parts that go into the making of the top are sewed on machines. At the present time more women than men are working at this operation. The work is light and offers splendid opportunities for men with artificial legs, trunk injuries, hernia, light forms of rheumatism, ankylosis of the knee or the hip, or other disabilities that would disqualify one for hard physical work. Women receive from \$14 to \$16 a week for a nine-hour day; men, on piece-work, make as much as \$23 per week.

Lasting. This work is done partly by hand and partly by machines. The hand worker, usually a woman, puts on the insole, the steel shank, the fabric shank, the counter, the rag sole, and the heel stay. The machine laster merely draws the vamp over the sole and fastens it in place with tacks. High grade shoes then go to a buffer who polishes the shoe with an emery wheel.

Cementing. The laster passes the shoe to another worker who spreads a thick coating of cement over the bottom of the shoe. One cementer does as many shoes as two lasters and two upperers. The work is done by women.

Uppering. The work of uppering on a tennis shoe is very light. It consists principally in putting on a narrow strip of rubber called foxing around the edge of the shoe and a tip on the toe.

Outsoling. A part of this operation is done by hand and a part by machinery. When women do outsoling, they simply put the sole in place, and the shoe is then taken to a machine which rolls the sole down and presses it on firmly. Where men are used for this work, they usually do the entire operation.

Automatic Rolling Machines. Many plants have installed automatic rolling machines for rolling down the soles. The machine is very complicated in structure but rather simple to operate. The worker sets the shoe in place, pushes a switch with the hand, and the machine carries the shoe under heavy rollers and back again to the place of starting. Most machines are double so that while one shoe is going through the machine, the operator can be setting another shoe in place. In this way he will roll as high as 30,000 or 40,000 shoes in one day. The work is very light and could be done by one who had an artificial leg, a stump of a hand, weak lungs, heart disease, defective hearing, trunk injuries, or hernia. Wages range from \$23 to \$28 per week for a nine-hour day. The average person can learn to operate the machine in less than a week's time.

Power Edging Machine. The power edging machine is made to be fastened to a post or standard at a height suitable to the operator. The principle parts are: A motor, a rubber hammer, and a steel edger. The hammer and edger are attached to a shaft which has direct connection with the motor. The machine is made so that the motor drives the hammer at a very rapid speed with a stroke of about one-half inch. The operator merely holds the shoe up against the hammer and the action of the machine rolls the sole down firmly. The edger works on the same principle as the hammer and the operator holds the shoe so that the sole is trimmed and the foxing is stitched at the same time. In many plants, women work at this operation and receive from \$19 to \$23 on piecework. Men who have lost a leg, who have weak lungs, heart disease, defective hearing, or trunk injuries, could do this work with satisfaction.

The women lasters, cementers, and upperers receive from \$14.50 to \$17 per week while women outsolers receive from \$16.25 to \$20 per week. Men outsolers average about \$23.

All wages are paid by the piece-work. Men operating power-edging machines and outsoling machines receive from \$19 to \$23 per week. Any of these operations can be learned by the average person in from one to two weeks' time, but it takes several months' experience for one to earn the highest wages. Outsoling, whether done by hand or by a machine, could, no doubt, be satisfactorily done by men who had lost a leg or men with weak lungs, heart disease, defective hearing, trunk injuries, or hernia.

Packing Rubber Footwear

Work in the packing room is varied and offers attractive employment to both men and women. The most important operations are treated in the following paragraphs:

Stripping Lasts. The shoes go from the curing room to the packing room. The first operation here is that of stripping. The floor men push the loaded cars to the stripper's table. The work of removing the shoes from the last is heavy work and requires a man with more than ordinary strength. Sometimes the shoes have to be pried loose from the last with an instrument. In some plants, this work is done at night. The work is not suited to handicapped men though the loss of one or two fingers or even the loss of a leg below the knee would not necessarily incapacitate one.

Trimming. The top of the lining of shoes and the binding around the top of boots must be trimmed off after the shoes come to the packing room. Some plants are, at the present time, employing women to do this work, though men are employed in large numbers. Sometimes a knife is used and sometimes a pair of shears. The work is not heavy but it is so varied that it is not suited to men with handicaps other than the loss of one or two fingers or defective hearing. Experienced workers make as high as \$35 per week on piece-work.

Wrapping. The best grades of footwear are carefully wrapped before being packed in cases. This work, in itself, could be done by a man who had lost a leg either above or below the knee, or who was afflicted with heart disease, paralysis,

defective hearing, or weak lungs. In most plants, however, the worker has other things to do besides wrapping shoes and, where this is true, men with the handicaps mentioned above would not be able to fit in.

Inspecting. The work of inspecting in the packing room involves so many different things that it is undesirable for handicapped men. The inspector must not only be competent to judge of the workmanship, but he must handle the goods and move about in the room continually. The inspector is paid by the day and receives from \$25 to \$27 per week for an eight-hour day. The work is light and the opportunities for advancement to executive positions are excellent.

Casing Out. This work consists in making up orders for shipment. The worker counts out the desired number of shoes of different sizes and lays them in order on the table ready to be packed in cases. The worker must walk back and forth from one table to another and carry frequently two or three dozen shoes in his arms at one time. While the work is not considered heavy, it requires able-bodied men to do it efficiently. Wages average from \$20 to \$22 a week for an eight-hour day.

Packing Cases. Many grades of shoes are packed in small cartons which hold one pair each; others are wrapped in paper; while others of lower grade are packed loose in large wooden cases. For the most part, the work of packing the shoes in cartons is done by women while the cartons themselves are put in the cases by men. The work of packing the cases varies so greatly that it is undesirable for handicapped men, though now and then an exceptional person who has lost a leg below the knee has done efficient work at this operation. It takes the average person about two weeks to learn to do this work well, and wages average about \$22 a week for an eight-hour day.

Making Mackintoshes

Stitching Cloth. The cloth to be prepared for making mackintoshes is brought to the stitching room where



Courtesy, Hood Rubber Co.

Boot making by the team work method.
(See page 41)



Courtesy, Hood Rubber Co.

Shipping rubber footwear. (See page 48)



Courtesy, Fisk Rubber Co., Chickopee Falls, Mass.

Cutting duck on the bias for making casings
The shears in the background cut the duck which is carried
by the endless belt to the bookers in the foreground

men turn out strips from 300 to 500 yards in length. The work is all done on sewing machines with special equipment so that the seams are trimmed as they are sewed. As the work is done while the operator is seated, a man who had lost a leg or had received other injuries to the lower extremities could do the work with full efficiency. The worker would need the use of both hands although the loss of one or two fingers would not incapacitate him. Wages range from \$18 to \$20 a week for a nine and three-quarters hour day. Opportunities for advancement to other work are not very pronounced but men who are wide awake may often be promoted to positions which pay better salaries.

Winding Machine. After the cloth has been stitched, it goes to a winding machine which rolls it smoothly on a mandrel eventually to be used on the spreading machine. The winding machine is very simple, consisting of a wooden frame about five feet high with a platform at the top about four feet square. Rollers are so arranged that the cloth is carried up the frame, across the platform, down to a roller at the bottom of the frame and from there to a mandrel which works in adjustable slots, that allow for play as the roll of cloth increases in size on the mandrel. The mandrel rests on top of two rollers, the function of which is to keep the cloth smooth and taut as it is being rolled up. The machine requires two operators and, aside from the lifting of the rolls, the work is very light. A man with a stump of a hand or with an artificial leg, provided he had a proper appliance, would be able to fit in with an able-bodied man in operating this machine. Wages average about \$3 a day.

Spreading Machine. The spreader is built somewhat on the lines of a calender but instead of two rolls there is one roll and a spreader knife. The knife sets above and a little to the back of the center of the roll. Soft rubber is

fed to the roll and as the cloth passes between the roll and the knife a coat of the desired thickness is spread over the cloth. On the old-style spreader there is a long platform back of the machine made of pipes which are heated by steam. As a rule, the platform is about four feet wide and from twelve to fifteen feet long. The function of the steam pipes is to dry the rubber so that the material can be handled without difficulty. One man operates the machine and must have two good hands in order to handle the soft rubber. In addition to operating the machine the man handles large tubs of cement. Lifting these tubs is heavy work and could not be done by men who have trunk injuries or hernia. Some foremen are of the opinion that a man who had lost a leg below the knee could, with a suitable appliance, do a full day's work. It requires from two to four weeks for a person to become competent in operating this machine. Wages average about \$22 per week at the present time.

Starching Machine. Material for single texture garments is starched before being cured. For this purpose a starching machine is used. It consists of a starch box with a roller at the top and one at the bottom and a brush box, containing a number of roller brushes. The material runs through the starch box where it is completely covered with starch. From here it goes to the brush box where the starch is spread by brushes. Operating this machine is very light work and could be done by one who had lost a leg, provided he had an appliance which would enable him to walk about considerably.

Black Dusting Machine. Material used in making campers' outfits is run through a machine that dusts a black preparation over the rubber coating. This machine is very similar to the starch machine and is operated in practically the same way.

Doubler Machine. After the cloth has been coated with rubber it is put through a doubler machine which takes two coated strips and presses them into a double sheet with the coated sides turned in. Rollers are arranged to smooth out all wrinkles and leave the two plies so that they appear as one. The operator receives \$22.50 per week, while the helper receives \$20 to \$21. The men must handle rolls which weigh from 200 to 300 pounds and move about considerably in operating the machine. It is possible that a man who had lost a leg could help to good advantage on this work, while the loss of one or two fingers would not be a handicap.

Special Curing. Material for mackintoshes is put through what is usually spoken of as a special curing process. The curing room is fitted with racks running the full length of the room and about ten feet high. The material is folded over these racks and hangs down on both sides, almost to the floor. About 300 yards is placed on one rack and about 2,000 yards in one heat. After the material comes from the curing room it is ready for the making department.

Laying Out and Marking Material. The prepared cloth is laid out on a long table and the patterns for the various parts of the coat are marked out. In most shops men do this work. Sometimes those who lay out and mark the material take turns with operators of electric cutting machines but this is not true in all plants. There is nothing about the work that could not be done by men who had lost three fingers or less on either hand. Defective hearing, hernia, weak lungs, or heart disease would not incapacitate one. Wages at the present time range from \$25 to \$30 per week.

Electric Cutting Machines. These machines are exactly like those described in connection with cutting material for the making of shoes and the work here is, on the

whole, of the same nature as that done in footwear plants.

Stitching. The garments are sewed rather than cemented and the work is done on regular sewing machines. Though women do most of the work, men are employed in many plants. The operation allows one to be seated and is, therefore, suitable to men with hernia, an artificial leg, ankylosis of the feet or legs, or slight trunk injuries. Two good hands are required for holding the cloth under the machine but the loss of one or two fingers except the first finger, on either hand, would not be a serious handicap. The wages range from \$19 to \$22 a week for a nine-hour day.

Strapping. Strapping consists in cementing strips of prepared fabric around the edges of the pockets and over the various seams of the garments. In the Apsley plant at Hudson, Mass., a man who has lost his right leg a few inches below the hip is doing this work with perfect satisfaction. The work can be done while the operator is seated and offers suitable opportunities for men who have had experience in the manufacture of rubber clothing.

Making Gum Coats

The material for gum coats is prepared on calender machines rather than on spreaders. Sometimes for special orders, the material is frictioned and then coated but, as a rule, only the latter process is used. The calenders are very similar to those described in connection with the manufacture of shoes and needs no further mention here. From the calender room the material goes to the cutting room where the various parts are cut out, some by hand and some by electric cutting machines. Gum coats are cemented rather than sewed.

Cementing. The work of cementing is done at tables and requires considerable walking on the part of the

worker. The principal tools used are the following: a metal roller, a rubber roller, a straight-edge, and an arm scye. The straight-edge, which is a piece of metal about three inches wide and twelve inches long, is used to make straight lines in putting on the cement. The arm scye is a round block of wood about ten inches in diameter and about eight and one-half inches high. The top end is made rounding so as to fit the opening for the sleeve.

There are many different styles of gum coats and the number of parts varies with the styles, though the operations are all about the same.

The loss of one or two fingers would not interfere with regular work. Men with slight trunk injuries, heart disease, or well controlled hernia could do the work without much difficulty. At the present time, about three-fourths of the workers are women who receive from \$16 to \$24 per week.

Curing Gum Coats. Each coat is hung on a hanger made so as to hold the shoulders and the neck of the coat perfectly smooth during the process of curing. The coats are carried into the room and placed in rows so that the air passes among them freely. It takes from three to five and one-half hours with a temperature around 250 degrees Fahrenheit to cure the coats. After the garments come from the curing room, the buckles or buttons, whichever are used, are put on and they are ready to go to the inspector.

Surface Goods

A brief description follows of the processes involved in making rubberized fabric for carriage and automobile tops and similar uses.

Surfacing. The rubber surface is put on surface goods either by a calender or by a spreader. In the case of the

calender process, the requirements are the same as those previously suggested.

Mixing Stock for Spreading Surface Goods. The rubber compound, which is spread on the fabric is mixed in large churns several feet in height. These churns are operated by machinery. The workers must see that they are properly supplied with compounds. This involves comparatively heavy lifting so that a man in this department should be able-bodied. The loss of two or three fingers or defective hearing would not necessarily handicap him. Wages are about \$20.

Spreading. This work has been described in connection with the operations involved in making mackintoshes.

Embossing. After the fabric has been treated with rubber in the spreaders or calenders, it is passed through an embossing machine. The embosser is similar in construction to the calender but is intended to give a final surface to the material. Where special embossing is desired a roll is placed in the machine which will leave the design on the fabric. The operator of this machine should be able-bodied in most respects although the loss of one or two fingers or defective hearing would not necessarily handicap him. He usually has one or two helpers. One of these men could do without a leg below the knee. The loss of one or two fingers or defective hearing would also not prevent him from doing his work. The operator would require one or two months' experience. His helpers could learn their work in a week or so. Wages for the operator are about \$21 a week; for the helpers about \$19.

Varnishing. In this machine the fabric after leaving the embosser is again coated with a rubber compound. The operation of this machine involves a fair amount of heavy lifting. Of the four men who do this work it is possible that one could be sufficiently relieved so that an

artificial leg below the knee, the loss of fingers, and defective hearing would not be serious handicaps. The operator in charge of the machine should, however, be able-bodied. One or two months' experience would be sufficient for the operator, and a week or two would offer sufficient training for helpers. The operator receives about \$21 and the helpers about \$19 per week.

Curing. After the varnished surface has been put on the fabric it is hung in a large curing room. This work is combined with varnishing and requires a thoroughly able-bodied man.

Miscellaneous Operations. In connection with the preparation and handling of cloth for piece-work there are a number of minor operations. The cloth must be inspected for quality and undue roughness. It must be carefully measured and wound, and the edges must be drawn out evenly before it goes to the spreader. The operations of inspecting are comparatively light and could be done by a man who had lost a leg below the knee or two or three fingers on one hand or who had defective hearing. Wages for various sorts of inspection range from \$10 to \$20. In the case of the lower wage, the work is at present done by women. The work of winding and stretching cloth would require able-bodied men with the possible exception of the loss of fingers. It pays about \$19 a week.

Medical Rubber Goods

There is a large number of rubber articles used in the treatment of patients and for the comfort of invalids that are classed together under the name of medical goods. For the most part, these goods are made in plants that specialize in this line of manufacture. They may be classified according to the processes involved in their manufacture as follows:

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*Hand Made Goods**a. Air Goods*

Air Beds
 Bed Pans
 Invalids' Cushions
 Camp Pillows
 Surgeons' Gloves
 Atomizer Bulbs

b. Water Goods

Ice Water Bags
 Throat Bags
 Spinal Bags
 Water Bottles
 Fountain Syringes
 Urinals

c. Bandages

Tourniquets
 Bands
 Dental Dams

Machine Made Goods

Cathereters
 Colon Tubes
 Rectal Tubes

Stomach Tubes
 Syringe Tubing
 Stoppers

Molded Goods

Water Bottles
 Syringe Tubes
 Marsh Finger Pads

Nipples
 Atomizer Tubes

Hand Made Goods. There is a large number of medical goods made by hand. They differ greatly in construction but the process of making is practically the same in all the articles. As a typical illustration of the entire class, we will consider the processes involved in making camp pillows, water bottles, and tourniquets.

Camp Pillows. The material for camp pillows is prepared on a spreader. The work is exactly like that described under a discussion of the spreading machine in connection with the manufacture of mackintoshes. The parts are cut by hand to the desired size, which is about twelve inches wide by eighteen inches long. From the

cutting tables the material is taken to the tables where the operator makes the pillow. The process of making is very simple. One piece is laid out on the table and a strip of friction tape is cemented across the center. The other piece is then laid on and the edges of this piece are firmly cemented to the edges of the first piece. The friction tape is cemented to both the upper and lower pieces. Its function is to divide the pillow so that, when it is inflated, there will be a low place in the middle of it.

At the present time the work is done mostly by women. It is very light and can be done while the operator is seated at a table, though some of the workers prefer to stand. The only thing that would debar a person who had received serious handicaps from working at this operation is the small wages paid. Women are paid from \$11 to \$12 per week.

Making Water Bottles. The material for water bottles is cut by dies and taken to the making room where women make the bottles. The edges of the side pieces are cemented together and a strip of rubber about three-quarters of an inch wide is cemented over the seam. Heavy pieces are cemented across the bottom of the bottle and pieces forming the mouth are cemented on the top. Either a piece of hard rubber or metal with threads into which the stopper may be screwed is cemented in the mouth of the water bottle. The operator places two or three bottles side by side in a pan ready to be conveyed to the curing room.

Making Tourniquets. The material for tourniquets is cut on a lathe in strips one and one-half inches wide and about fifty feet long. From the lathe the material goes to a folding and pressing machine which folds the edges over so as to make a double strip three-quarters of an inch wide. The machine consists of a piece of steel with a slot in it which folds the strip so that the edges meet evenly. Back

RUBBER INDUSTRY

of the folder is a rubber roller which presses the two plies firmly together. Girls operate this machine. From here it goes to the cutting tables where the strips are cut into lengths of about forty inches. The work of cutting is done by men. It is very light and could be done by one who had lost a leg below the knee or who had trunk injuries, defective hearing, rheumatism, or hernia. From the cutting room, it goes to the making room. The only thing that is to be done is the folding of the ends. First, a strip of friction tape is cemented on where the fold comes and then the end is turned over and rolled down with a heavy rubber roller. To make the fold as firm as possible it is stitched with a corrugated steel roller. A chain is inserted in one end and a snap in the other. The purpose of the chain and snap is to fasten the ends of the tourniquet after it has been wrapped around a limb. Wages range from 20 to 22 cents an hour for this work.

Stomach Tubes. As typical of the machine-made goods, the making of stomach tubes will be described. The material for stomach tubes is turned out on seamless tubing machines. This work has been described under the making of mechanical goods. As the tubing comes from the machine, it is in strips about fifty feet long. The next operation is to cut it into the proper lengths. The operator then takes these lengths and places a piece of soft rubber in one end and rolls the end down to a point. The rolling is done on a block with a smooth piece of wood. The rubber tubes are then inserted in glass tubes, the inside of which is the size of the outside of the rubber tubes. Catheters, colon, rectal, and stomach tubes vary in sizes from one sixty-fourth to ten sixty-fourths of an inch in diameter. We often speak of these tubes as being as smooth as glass and it is true because they are molded against glass. After the tube has been inserted in the glass, it is partly filled with water and then inflated with

air. As the water is heated, it expands and presses the rubber tubing firmly against the glass tube. A piece of cloth is now tied over the end of the glass tube and the material is ready for curing. After they come from the curing room, the rubber tubes are drawn from the glass tubes. This work is usually done by men as it requires considerable strength to extract the rubber tubes.

Most of the work of making stomach tubes is done while the operator is seated at a table and offers splendid opportunities for men who have lost a leg or who have defective hearing, trunk injuries, or hernia. Girls receive from 20 to 22 cents an hour while men are paid 25 to 33 cents an hour.

Molding Water Bottles. A description of molding water bottles and atomizer tubes will be given as typical of the making of molded goods. The molds used in making water bottles consist of two plates and a form, the shape of the inside of a water bottle. Each plate contains an imprint which is the exact shape of the outside of the water bottle. A piece of rubber is laid over one plate and a form the shape of the inside of the water bottle is placed on the rubber. Another piece of rubber is laid over this and the top plate is fastened on. The mold is now put in a hydraulic press and heated by steam until the rubber parts are molded into one piece.

The work is light and could be done satisfactorily by a man who had lost a leg below the knee, two or three fingers on either hand, or who had slight trunk injuries, defective hearing, or hernia. The greatest drawback is the temperature of the room which is, as a rule, uncomfortable on account of the presence of a number of heated presses. Wages range from \$22 to \$25 a week.

Molding Atomizer Tubes. Atomizers consist of three parts, the bottle, the rubber bulk, and the rubber fittings. The rubber fittings are first molded and then bent into

the desired shape. The work of molding is very similar to that of making water bottles, the only difference being in the shape of the molds. Tubes of different sizes and shapes are made. After they have been molded, they are taken to a table where, by means of heated plates, the tubes are bent into any desired shape. The bending plate is about three inches wide and twelve inches long. There are six or eight holes in it varying in size to fit different tubes. A steam chamber surrounds the holes so that the plate is heated evenly. The work of bending consists in placing the rubber tubing in these holes and, when it has become heated to the proper temperature, bending them by hand into the desired shape. The work is very light and the loss of two or more fingers of the left hand, trunk injuries, hernia, defective hearing, or the loss of a leg either above or below the knee would not incapacitate one.

Mechanical Rubber Goods

Mechanical Rubber Products. The mechanical rubber industry includes the production of the following articles: (1) small press goods (soles, heels, washers, gaskets, valves, small solid tires, small molded mats); (2) jar rubbers; (3) small hose; (4) large hose, including fire and suction hose; (5) friction tape; (6) rubber mats; (7) transmission and conveyor belting; (8) packing (sheet and spiral); (9) roll covering for printing shops, paper mills, etc.; (10) insulated wire and cable; (11) surface goods; (12) leatherette; (13) small brass fittings.

The discussion of surface goods appears in another section of this report, though it is ordinarily classed as belonging to mechanical goods. Leatherette, although not a rubber product, has grown out of surfacing processes and consequently its manufacture is frequently carried on in mechanical rubber plants. The foundry and

brass finishing departments supply connections and other attachments for mechanical rubber products, and consequently are frequently found where mechanical rubber goods are made.

At the present time mechanical rubber workers spend nine or ten hours a day in their departments with varying conditions of Saturday afternoon employment. This would make forty-eight to fifty-four hours of work a week. In the case of women employees in certain factories, the working hours per week may be even less than this.

In general, working conditions are good, and in many cases excellent. Many factory buildings are comparatively modern so that lighting and ventilation are equal to those of the average home. In certain departments a small amount of soapstone dust is constantly in the air, though the foremen in these departments stoutly maintain that this does no harm. In fact, one or two of the healthiest looking foremen in the plant have been found in such departments. Certain elements of the work bring special conditions of heat which cannot be completely overcome, and in the case of a few operations, the worker will have to handle wet material.

There is little doubt now that the mechanical rubber industry has not only come to stay, but that it will increase in its scope very markedly within the next few years. An instance of the increasing demand for rubber goods is that of soles and heels, which seem to be gradually and permanently taking the place of leather soles and heels. Consequently, mechanical rubber ought to offer as permanent occupation as any industry after the war. Not only will the occupation be permanent from year to year, but it will also vary only slightly from season to season. The seasonal factor is not entirely eliminated, but it is by no means as prominent as in many other occupations.

RUBBER INDUSTRY

The question naturally arises as to the attitude of employers in mechanical rubber factories concerning the hiring and training of disabled men. At present, there seems to be marked unanimity and even enthusiasm among superintendents. They are all willing to give the war cripple an opportunity to make himself self-supporting and self-respecting. One foreman emphatically said, "I would a damned sight rather hire a soldier with one arm than a quitter with eight!" Some of this enthusiasm undoubtedly has grown out of immediate conditions; but on the other hand, manufacturers are beginning to give the problem of rehabilitation careful thought, and have reached their conclusions after careful consideration, not only of their patriotic duty, but also of the economic obligations which will be placed upon them in operating their factories at the close of the war.

SMALL PRESS GOODS

After the rubber is passed through the calender it is ready to be made up into various articles. Some of it leaves the calender in rubber sheets of varying thicknesses and widths. Other rubber is put on fabrics of different kinds and qualities to be used later in manufacture of surfaced goods. The rubber which goes to the small press department may or may not be combined with fabric. Generally, it is to be molded into articles one-eighth of an inch or more in thickness. Some of these articles have been suggested in the early part of this discussion. The making of soles and heels will be taken as a typical process.

The Manufacture of Soles and Heels. Stock is cut to the desired size and dimensions in two ways. It may be cut on a dinking machine from sheet stock, or it may be molded in a tubing machine to the right cross section dimensions and be cut into the proper thickness from long

strips. The dinking machine is simply a press. The rubber sheet is placed under the top plate of this machine. A die the desired size and shape is then placed over the stock and the material punched out. The machine is sufficiently large so that a number of soles or heels can be cut without moving the rubber stock. The press is released by foot power. In operating this machine speed is an important factor. The worker must set his die in position and cut the sole or heel without marked interruption. This demands excellent muscular coordination, as a wrong move on his part might cause the loss of fingers or a hand. Any member which might be caught between the upper part of the press and the die would undoubtedly be seriously mangled.

Because of the need of constant activity and care, the worker should be able-bodied. The loss of one or two fingers on either hand would not prove a serious handicap. In some cases foremen seem to be willing to accept a man for this work who had lost a leg below the knee, providing he was sufficiently agile to move about and operate the tread with his other leg. In many factories men learn to operate dinking machines by being helpers at first. As the work involves a certain amount of dexterity, two or three months would be required for the average man to become efficient. The wages vary from \$20 to \$25 a week for piece-work.

Where washers or circular gaskets are too large to be cut on the dinking machine, they are cut on a machine which is constructed somewhat similar to a drill press except that a knife set at the desired radius revolves about the central spindle. This machine is generally used for cutting washers over nine inches in diameter. In general, the stock which is handled in this machine is comparatively heavy, though otherwise the work is light. The loss of not more than two fingers on one or both hands, loss of a

leg below the knee, slight stiffness of the knee or hip joints in one leg, or defective hearing, ought not to disqualify the worker providing he could devote all his time to this type of work. The wages paid here are about the same as those received on a dinking machine.

Tubing Machine. The tubing machine is used with certain variations in a number of processes in the mechanical rubber industry. In the case of manufacturing heels, the heel rubber is run out in lengths of about thirty-six inches and then cut up into heel widths. The machine in its general construction is very similar to the common meat grinder in a butcher shop. Instead of feeding meat into the hopper at the top, rubber is forced into it. The rubber comes out at the side in various sizes and forms according to the die which is placed on the tubing machine. Dies may be interchanged for various sorts of work. Three men generally operate the tubing machine, though in some cases four or five may be employed. One man acts as operator and the rest as helpers. The duties of the operator vary slightly in different plants. In some cases they are such that the man could get along with an artificial leg below the knee. Loss of fingers or of a hand or arm below the elbow might not prove insurmountable handicaps in some factories. Stiffness of any joint in one leg, or of the elbow joint in one arm, or slightly defective hearing ought not to completely incapacitate an operator. What is true of the operator is equally true of the helpers with regard to injuries, providing that at one machine there is not more than one disabled man. In this work the operator must understand the heats required in a tubing machine to make the rubber desirably pliable. Necessary familiarity with heats or desirable temperatures may be acquired in two or three months. The helpers could very well learn their work in a few days. The wages range

from \$19 to \$25, in various factories, the lower figures being those for helpers.

Vulcanizing. The molds for small press goods are generally from twelve to twenty-four inches square. They are made in two halves and contain the number of impressions of desired dimensions. The stock which has already been cut to approximately the size is placed in the mold and the two halves put together. The mold is then placed in a hydraulic press, where under the influence of heat and pressure, the rubber is cured. In the curing process the rubber stock fills out the mold.

Most of the molds are comparatively heavy, and as the worker stands directly in front of his press there is considerable heat. The loss of one or two fingers or defective hearing seem to be the only disabilities feasible in this sort of work. However, if arrangements could be made for one man to handle the lighter presses, the loss of a leg or even a hand or of an arm below the elbow might not seriously handicap him. The operation of a small press could be learned in three weeks' time. The wages range from \$20 to \$30, and even in pre-war times small press work was comparatively well paid. In discussing the operation of small presses, the making of heels and soles has been selected as a characteristic example, though a large variety of small rubber articles are made in this way.

Trimming. After the soles and heels have been removed from the press there are little edges remaining on them where the rubber has been forced out over the face of the mold. This must be trimmed off. Practically all of the trimming is now done by girls and women. Some is done by hand and some is done on a small machine where circular knives revolve rapidly. As trimming is a somewhat minor operation, it must be done very rapidly in order to keep the cost down. For this reason girls seem

second cuts the tubing into strips, while a third operator puts the strips on a mandrel. The fourth man loads the mandrels of the rubber tubing on small wheel trucks. The feeder might have any of the disabilities already mentioned in connection with feeding the tubing machine in the manufacture of rubber heels. The man who cuts the strips could work with the loss of one leg, either above or below the knee, and the loss of fingers on one hand, the loss of a hand or one arm below the elbow. Neither hernia nor defective hearing would prove serious handicaps. The other two helpers who handle the mandrels would need to be fairly able-bodied. Loss of one or two fingers or defective hearing would not seriously handicap them. The length of time required for the feeder to learn the work would be the same as that suggested in connection with the making of rubber heels. Helpers on the machine could learn their work in a few days' time. The wages for this work are about \$19 or \$20 a week.

Curing. After the jar ring tubes have been placed on the mandrel they are taken to a vulcanizer, which has a cylindrical chamber sufficiently large to accommodate trucks such as are used in factories. Some of these chambers are fifty feet in length and six or eight feet in diameter. Where there are only one or two vulcanizers in the department, their operation does not require the entire time of one man. After they have been filled and sealed there is no work connected with operating them except to see that the required temperature is maintained and that the rubber remains in them the desired length of time. Where a number of these vulcanizers are run together the heats could be cared for by a man with certain disabilities, providing the operation of the doors was not one of his duties. Loss of fingers or of a hand or arm either above or below the elbow, stiffness of joints in one arm or one leg, or trunk injuries or defective hearing would not pre-

vent a man from caring for heats. Familiarity with heats and rubber would be a prerequisite in this work, so that two or three months' experience would be expected before the vulcanizers could be trusted to an operator. The wages are about \$19 a week.

Stripping. This work consists in blowing the tube off the metal mandrel after it has been taken from the vulcanizer. The work is comparatively heavy, so that loss of not more than three fingers on one hand, slightly defective sight or hearing would be the only possible handicaps. The work can be learned in a comparatively short time. The wages are about \$19 a week.

Jar Ring Stock Room. Jar ring stock after curing is stored until it is needed for cutting into rings. This work is comparatively light. Loss of fingers, of a hand or arm, or slightly defective hearing would not prove serious handicaps. The man who does this work, however, needs to have a common school education. The wages are about \$19.

Blowing On. When the cured tube is to be cut into jar rings, it is blown on a mandrel with the assistance of compressed air. This second mandrel is wound with tape so that cutting knives will not come in contact with the metal. The operation of blowing on is combined with that of stripping. Loss of fingers or a leg below the knee, stiffness of any joint in one leg, or defective hearing would not bar the worker either in blowing on or in stripping. It is also possible that slight stiffness of the body muscles would not prove a serious hindrance to workmen in either of these operations. As this work involves a certain dexterity in handling the compressed air mechanism, it would require three or four weeks before the worker could make satisfactory speed. The wages are about \$19 a week.

Cutting Jar Rings. After the tube has been blown on, the tape-wound mandrel is placed between the centers of a

lathe. The carriage of this lathe carries from two to four circular knives which are automatically lifted and dropped on the tube as the carriage travels along its length. In this way the rings are cut to the required thickness. One lathe operator generally has two or three machines under his direction. After he has learned to place his mandrel properly between the centers, little more is demanded of him in the way of training. The knives are generally set by some one else and the machine stops automatically when the jar rings are cut. Although this work does not require any great amount of skill, men are apt to be advanced to it who have been blowing on or stripping tubing. This is probably due to the fact that the work is more attractive. The loss of a leg below the knee, providing this loss does not interfere with standing or moving from one machine to another, would not prevent one from doing this work. Loss of two or three fingers on one hand, or stiffness of the knee joint in one leg, or defective hearing, or slight stiffness of the trunk would also not be serious handicaps. Wages are about \$19 a week.

Breaking Jar Rings. After the jar rings are removed from the mandrel in the stripping process, they are put into a machine which pulls them apart. The work is comparatively light, and disabilities for operating this machine are the same as for cutting jar rings.

Covering Mandrels with Tape. As the knives which cut the jar rings pass through into the tape on the mandrel, it is necessary from time to time to rewind the mandrel. Unless the output of jar rings is exceedingly large, this work does not offer full-time employment for one man. It is, however, attractive for men with certain disabilities and could probably be combined with other employment of similar character. A mandrel is placed between the centers of the lathe and the tape is wound on very tightly. When, approximately, the right diameter is obtained, the

tape is trimmed on a lathe so that the tubing will fit snugly over it. This work could be done by any one with the disabilities specified for cutting jar rings. A little longer training, however, would be required. The salary, when this work was done continuously, would be practically the same as that for cutting the rings.

Counting and Packing Jar Rings. Jar rings are counted by hand, as no satisfactory mechanical device has yet been perfected for doing this work. The folding and sealing of boxes, which hold a dozen jar rings, is done either mechanically or by hand. Practically all of this work is at present done by girls. It requires rapid manipulation, though the operator may be seated. The work would probably be undesirable for men, as wages are small on a piece-work basis. The wages range from \$10 to \$15.

Sealing and Shipping Boxes. After the jar rings are packed in gross boxes, they are ready to be put into shipping boxes which are made of corrugated cardboard. The upper cover of the shipping boxes is fastened down by the worker who also handles boxes. This, therefore, is comparatively heavy work. Loss of fingers or defective hearing would not prove serious handicaps. The work can be learned in a few days. Wages are \$18 or \$19 a week.

SMALL HOSE

Included under small hose are all hose of relatively small diameter which do not have to stand unusually high pressure. Among the hose in this class are garden and gas hose. Hose of this grade is generally a combination of rubber and fabric put together in different ways. It may be divided roughly into hand-made, braided, and molded hose.

Hand-Made Hose. The production of hand-made hose can be divided roughly into two parts, the making of the rubber tube and the building up of the fabric and rubber outer casing.

Making of Rubber Tube. The inner surface of small hose is generally rubber. This is made in the form of a tube on the tubing machine. The operation of the tubing machine has already been discussed. As the tube is taken from the machine, it is wound in a tray and dusted with soapstone. The tubing is next cut into desired lengths, generally fifty feet, and is blown on a mandrel. The blowing on process, as has already been suggested, consists of expanding the tube slightly with the assistance of compressed air so that it can be readily drawn over the mandrel. Even in the case of the smaller tubes this work is generally heavy, as it involves the handling of the fifty-foot lengths of metal over which the tubing is drawn. Consequently, the worker would need to be able-bodied, with the exception of possible loss of two or three fingers on one hand, or defective hearing. Two or three weeks would be sufficient time to become familiar with blowing on. Wages are about \$21 per week.

Making-Up. After the tubing has been blown on the mandrel, it goes to the making-up department. The work in this department is done at tables sufficiently long to accommodate fifty-foot lengths of hose. The operations here vary considerably in different factories. In some factories the entire work of making-up is done at a single table, whereas in others the different operations have been segregated, so that one man is constantly employed in a single operation. The latter scheme seems to be the more desirable from the standpoint of factory efficiency. The objection that the work becomes monotonous could be overcome by shifting the men from time to time from one operation to another where this would seem advantageous.

In discussing the process of making-up, the operations will be treated separately; though, as they require practically the same physical abilities, the discussion would apply equally well in factories where they are combined.

When the rubber center reaches the making-up department, it is first wound with duck after being cemented. This duck middle is made by cutting duck strips previously treated with rubber in the calender department. These strips are cut and pieced together on the bias in order to give greater strength to the hose. The cutting is done by hand or by machinery. In the case of cutting by hand, the operator working at a long table cuts the duck as it comes from the roll. He must work rapidly and at the same time accurately. The strips which he cuts are taken by the blocker, who pieces them together in a long strip four or more inches in width, according to the number of plies desired. The strip is then wound on rolls by a helper, and in some cases the helper also assists in handling the stock at the table. The work of cutting requires activity both of legs and arms. Loss of two or three fingers, heart disease, hernia, or defective hearing would not necessarily handicap the cutter. Practically the same disabilities apply to the blocker and helper. Inasmuch as the cutter must work rapidly, it requires one or two months' experience in order to reach a desirable degree of efficiency. The blocker could pick up his work in a week's time and the helper in a few days. In cutting the stock by machinery, the fabric passes under a long blade from four to six or eight feet in length which operates mechanically in the same manner as the common paper cutter. The work is similar in other respects to hand cutting, and involves the same disabilities. Cutters receive \$22 to \$25, blockers about \$15, and helpers, who are generally boys, about \$12 a week.

After the duck has been cut and blocked, it is sent to the making-up room. In some factories this is simply a matter of carrying; in others mechanical devices have been installed by which the duck is carried by an apron, or some similar device, to the making-up table. Where the apron conveyor is used, one or two helpers are required for its operation, which is comparatively light work. At least one of the helpers could work with the loss of a leg either above or below the knee, loss of fingers, hand or arm, hernia, stiffness of joints in one leg or one arm, or defective hearing. In some cases girls are doing a portion of this work. Experience of a day or two would be sufficient training. The wages range from \$12 to \$20 according to the operation.

The first operation in making-up is rolling on of the duck middle. One edge of the duck is fastened to the tube, and rolling on is accomplished by placing the tube with the duck between three revolving rolls which wind the duck tightly and smoothly about the tube. In some cases this operation is divided into two parts: (1) fastening the duck edge to the tube; (2) rolling the duck on the tube. The rubber cover is wound about the duck middle in a similar fashion at another table. The cementing of the tube before the duck middle is put on is sometimes done at a separate table also. After the rubber cover has been put on, the hose is ready to be cured. Before it is placed in the curing oven it must be wound with a moist cloth. In the case of smaller hose the cloth may be wound on after the fashion of the duck middle and rubber cover. In the case of larger hose, the cloth comes in strips of a few inches' width and this is wound on in overlapping, spiral form. The object of wrapping is to have the strong, firm pressure on the outside of the hose so that it will not expand unevenly or to too great extent. From the wrap-

ping table the hose is placed on a truck, which is run into the curing oven.

Vulcanizing. What has previously been said of the care of vulcanizers applies equally in the case of hose vulcanizers. Where a number of these are grouped together, a disabled man could have charge of all of them. These vulcanizers are similar in shape and general dimensions to the vulcanizers used for curing jar rubbers.

Stripping. After the hose has been cured, the fabric wrapping is removed. This is comparatively heavy work as it involves handling the hose. With the exception of loss of two or three fingers or defective hearing the worker should be able-bodied. The work could be learned in one or two weeks. The wages are \$20 to \$25 per week.

Blowing Off. The hose is next removed from the mandrel. This is done by again expanding it by compressed air and drawing it off. The work is comparatively heavy and requires an active man in good general physical condition. There is considerable noise in this work resulting from the compressed air working around in the hose.

With the exception of loss of two or three fingers on one hand, or defective hearing, the workers should be generally sound. The wages are between \$20 and \$25 a week.

Preparation for Shipping. In connection with this work there are two or three minor operations. One consists of drawing the hose out at full length preparatory to rolling it up. Another consists of trimming the hose ends and attaching couplings. A third consists of winding and inspecting the hose. Wages here range from \$16.50 to \$21. The straightening out of the hose could be done by a man who had lost one hand, or one arm either below or above the elbow. The work involves considerable activity in the legs and trunk, so that injuries to either would disqualify the worker. No training is required for this task. Attaching couplings is done by a semi-mechan-

ical process. The worker might have lost two or three fingers of one hand, but with the exception of defective hearing should be able-bodied in other respects. Inspecting requires a general knowledge of the process of manufacture and familiarity with various qualities of rubber. The work is comparatively heavy, so that the physical requirements are the same as for putting on couplings.

Molded Hose. Where it is desirable to obtain unusual lengths of hose without joints, it is not practicable to make the hose by the method just described. It is necessary to use a device by which the hose can be cured in any length. This device is a very large press which is grooved to the same diameter as that of the hose. In some of these presses the grooves run lengthwise; in others the press is circular in form and the grooves form a spiral. The upper plate of the press is exceedingly heavy and is lifted either hydraulically or with the assistance of a chain fall.

Making of Molded Hose. Instead of building the hose in the manner previously suggested, the duck middle is braided around the tube. The various plies of duck are put on separately, each ply having a thin coating of rubber between it and the next. These thin coatings are put on by running the hose through the tubing machine, and of course the outer rubber cover is put on in the same manner. The operation of the tubing machine is similar to that already described. The machine itself is slightly different, inasmuch as it permits the hose which is to be coated to pass through it from one side to the other.

Braiding. The braided middle for this hose is put on in looms. The hose passes up through the center of the loom and the braid is put on by a system of spools of cotton thread which follow a crossing, zigzag course around a circular table. The operation of these looms is largely given to women. It requires a fair amount of activity, though loss of two or three fingers on one hand,

hernia, or defective hearing would not prove serious handicaps. Wages at present are about \$14 a week.

Vulcanizing. The general construction of the vulcanizer for molded hose has already been described. In the case of the rectangular vulcanizer the hose runs from one mold groove to another in a loop which projects beyond the mold. This demands a second curing in which the section of the hose not included in the first curing is placed in the mold. The interior diameter of the hose is maintained throughout the curing process by air pressure. In the case of the circular mold the entire length of hose may be cured at one time. The operation of these presses requires an able-bodied man, though the loss of thumb or one or two fingers, or defective hearing, would not prove serious difficulties. Wages average \$20 a week.

Braided Hose. The process of the operations in making the braided hose has already been discussed under molded hose. The braid is built up in the manner suggested in that discussion. The curing, however, is not always done in a mold. The hose may be wrapped and cured in an oven rather than a mold vulcanizer.

LARGE HOSE

Under this heading is included fire hose, air-brake hose, vacuum hose, and suction hose. Most of these hose are made by hand.

FIRE HOSE

Cutting Stock. Fire hose is made by hand. In some instances, the inside rubber tube may be made on the tubing machine. This process is the same as that described in connection with other hose-making, except that a larger die is used in the tubing machine. Most of the tubes for fire hose, however, are made by hand. The rubber stock for the tube comes from a calender. It is

would need both his hands unless an extraordinarily well-designed appliance could be fitted to a stump arm to assist in folding the edges together. The loss of a leg below the knee, as in the case of cutting, would not be a serious handicap. This operation would require about a month's training. Wages for this work range from \$21 to \$25 a week.

Semi-Curing. After the tubes have been made they are laid out in long pans. These pans are put into a vulcanizer and the tube is semi-cured. This work is generally done by men from the cutting and making-up tables, or by other helpers in the department. Unless the making of hose were done on a very large scale, there would probably not be sufficient vulcanizing in this department to require the entire time of one man, so that the recommendations previously given for the care of a group of vulcanizers would not apply here.

Backing Tubes. In order that the tube shall adhere firmly to the cotton cover after the final curing, it is wrapped with a layer of gummed rubber after the semi-curing. This work is done at long tables in a manner similar to making-up. The disabilities in this work would be practically the same as those permissible in making-up. The wages are about \$18 a week.

Spooling Cotton. The rubber inside and the cotton cover of fire hose are made separately. The making of the rubber inside has already been described. The cotton thread which goes to make up the fire hose comes in large spools. It is necessary to wind some of this cotton on smaller spools. This work is done at a machine somewhat similar to a lathe. In some factories this work requires the entire time of one man. The loss of a leg above or below the knee would not prevent one from working here, as arrangements could probably be made for the man to be seated a portion of the time. Loss of two or three

fingers on one hand, hernia, stiffness of the knee joints in one leg, or slight stiffness of the trunk, or defective hearing would also not unduly handicap the worker. A week's time would offer sufficient training. Wages are \$18 or \$20.

Weaving Hose Fabric. The weaving of hose fabric is somewhat similar to braiding, except that there is a warp and woof in the fabric. Furthermore, in the case of most hose the cotton jacket is not woven directly on the hose. Instead of having the bobbins moving in and out, two series of threads are alternately raised and lowered while a pair of bobbins pass between them. This operation reminds one of the making of carpets or of similar material. Most of the looms for weaving large hose covers are operated by women. In a few cases there are men operators. The loss of two or three fingers on one hand, or the loss of a hand, or arm below the elbow, stiffness of wrist joint in one hand, hernia, or defective hearing would not prevent one from doing this work. Wages are \$18 or \$20 a week for men.

Twisting Cotton into Plies. In the making of the heavier hose covers, it is necessary to have the cotton in several plies. The devices for twisting the cotton vary somewhat. In a machine that is commonly used, the thread comes from the desired number of spools and passes through a series of holes in a revolving disk. This disk twists the cotton into a single thread which is rewound on a spool on the opposite side of the disk. In some factories these machines are operated by men; in others by women. The work is not heavy. It consists largely in seeing that the spools are not allowed to run out and that breaks in threads are mended at once. The loss of fingers on one hand, the loss of a hand or arm above or below the elbow, or the loss of a leg above or below the knee, stiff joints in one arm or leg, hernia, or stiffness of trunk muscles would not prevent one from doing this work on certain types of

machines. There is nothing in the work itself which would be undesirable for a man with slight nervous disorders. However, the machinery makes a certain amount of noise, and in some factories the work is done in the

weaving room where the looms are exceedingly noisy. The work can easily be learned in a week's time. The wages are about \$18 a week.

Inspecting and Winding Hose Fabric. As the hose fabric comes from the looms it is cut into lengths somewhat under fifty feet. In some cases this length is about forty-eight feet, though it varies with different qualities and sizes of hose. It is taken to the inspecting table where any faults in the weaving are detected. The worker here also winds the hose fabric in a roll before it leaves him. The loss of fingers on one hand, the loss of a hand, or arm below the elbow, or a leg below the knee, stiffness of elbow joint in one arm, or any joint in one leg, or slight stiffness of trunk muscles, hernia, or defective hearing would not prevent one from doing this work. The work itself requires care and familiarity with the varieties of material inspected. The disabled man should, therefore, have perfect eyesight and good muscular and mental control. The work itself would require two or three months' training. The wages are \$18 to \$20 a week.

Stretching Hose Fabric. In order that the fabric shall not stretch after it is made into the hose, it is cut in lengths less than those desired and stretched before the tube is drawn through. In the case of the forty-eight-foot length, the hose is drawn out to fifty feet. This work is done by running a hose through a roll machine which gives the desired amount of tension. The loss of a leg below the knee, loss of two or three fingers on one hand, hernia, or defective hearing would not prevent a man from doing this work. A week's time would offer sufficient training. The wages are from \$18 to \$20 a week.

Drawing On. After the backing has been placed on the rubber tube, it is ready to have the cotton cover drawn on. This work is done at a long table. A rope is drawn through the cotton cover and one end attached to the tube. The tube is then drawn through with the assistance of mechanical tubes which wind in the rope. This work requires two men. One of these men should be able-bodied. The second, however, could get along with the loss of a leg below the knee, loss of two or three fingers on one hand, or defective hearing. A week's time would offer sufficient training for either man. The wages are about \$20 a week. The hose is now ready for the final curing. It is not, however, placed in a vulcanizer, as is customary in most operations of curing. The ends of the hose are clamped to iron nozzles which are connected with the steam system. Steam is then allowed to fill the hose, and in this way the curing is done. The work is moderately heavy, as the clamping of the hose ends must be firm, though the loss of a leg below the knee would not incapacitate one of the workers. The loss of two or three fingers on a hand or defective hearing would not be serious handicaps to either worker. The routine of the work could be learned in a few days. Wages are about \$21 a week.

Winding Hose. After the hose is cured it is wound in a roll. This winding is done over a drum. In some factories it would offer full-time employment for one man, but it is not difficult and could be learned easily in a day. Loss of fingers on one hand, loss of a hand, or arm below the elbow, stiffness of wrist joints in one hand would not seriously interfere with this operation. The wages are about \$18 a week.

Fastening Couplings. As in the case of small hose, couplings are fastened to either end of the hose before it is shipped. This is done with the assistance of a mechanical

device, which forces the hose against the coupling by expanding an inside collar. The loss of two or three fingers on one hand, or of a leg below the knee, hernia, or defective hearing would not prevent a man from doing this work. One or two days would be sufficient for acquiring familiarity with this operation. The wages are about \$20 a week.

Feeding Rubber Tubes into Elevated Looms. Where the cotton jacket is woven directly around the rubber tube, the tube passes up through the center of the loom. Some factories place these looms on a platform elevated six or eight feet above the floor of the plant. This permits the easy manipulation of the rubber tubing. The feeding of this tubing to the loom in some cases requires the entire time of a man. The work is not particularly arduous. It simply involves keeping the tubing from tangling, etc. There is a certain amount of lifting and handling of tubes. The loss of a leg below the knee, loss of fingers or of an arm below the elbow, or defective hearing would not disqualify a worker in this operation. Wages are about \$18 a week.

Suction Hose. Suction hose must be made with exceeding care, as it is required to stand high pressures and general rough treatment. The work is done entirely by hand and resembles in some respects the operation of roll covering, to be described later.

Duck Building. In some cases, the ends of suction hose are especially reinforced, so that the coupling joints will be strong. This reinforcing is called 'duck building'. At either end of the mandrel, on which the hose is to be built, is wound a small amount of friction cloth, thus giving extra strength at the extremities. This is a minor operation and does not require the entire time of one man. He is employed a portion of the time in stripping or similar work, so that disabilities which apply to strip-

ping will apply equally here. The salary is about \$21 a week.

Butting On. After the ends of the hose have been reinforced, the inner rubber tube is put on the mandrel. This consists of a long strip of rubber cut in width equal to the inside diameter of the hose. The work is done at a long table and consists of rolling the rubber strip over the mandrel and fastening the edges firmly together. The work involves considerable moving about, and the operator would need both hands. Loss of two or three fingers on one hand, however, heart trouble, hernia, or defective hearing would not seriously interfere with his doing this work. One or two months' time would be required to gain desirable familiarity with the operation. The wages are about \$21 a week.

Winding on Wire. In order to give unusual strength to the hose, it is often wound with heavy wire. The mandrel is placed between the centers of a lathe and revolved. The wire is guided along the length of the tube by the carriage. Space of a half an inch or more is left between the strands of wire as they are spiraled around the hose. In some cases the wire is put on before the final covering, while in others it is put on over this covering. The work demands an able-bodied man. However, loss of two or three fingers on one hand, hernia, or defective hearing would not seriously handicap him. The wages are about \$20 a week.

Stringing Hose. In some instances, hose is wound with heavy string in a manner similar to that employed in winding with wire. This also is done in order to give unusual strength to the hose. The operation is similar to the one just described and involves the same disabilities. Where a helper is employed, his wages are \$19; while those for the operator are about \$21 a week.

Making Hose. With the exception of the points noted, the heavier hose is made in a manner similar to that described under the heading, 'Hand-Made Hose'. Disabilities and wages are about the same.

The operations of wrapping, vulcanizing, stripping, and tying are also similar to those previously described.

Painting. A great deal of the suction hose is painted before it is shipped. This is exceedingly dirty work. The paint is poured out in long troughs and the hose is drawn through it. The workman must keep both his hands in the paint, as he uses them to wipe off the surplus which adheres to the fabric of the hose. With the exception of loss of fingers or defective hearing, he should be able-bodied. The work pays from \$18 to \$21 a week.

FRICION TAPE

In making friction tape, it is necessary that the rubber compound be forced into the fabric, and this is accomplished on a calender or spreader by operating the rolls at different speeds, thus working the compound through the duck. This work is similar to other calendering processes as regards disabilities and wages.

Stretching Friction Cloth. In the treatment of friction cloth for certain purposes it is necessary that the edges be drawn out exactly. This work is done in some factories by a mechanical stretcher employing about three men. One of these men could do the work with the loss of a leg, either below or above the knee; hernia or defective hearing would also not be serious handicaps. The other two workers should be able-bodied. The work could be learned in a few weeks in the case of the operator. The helper would require only a few days' training. Wages for the operator are about \$22 a week, for the helper about \$19.

Cutting Tape. Friction tape is cut into wide or narrow strips after it has been rolled. In the case of the wide tape the outer edges are trimmed off. This is done by revolving the roll against a sharp knife. The loss of a leg below the knee would not prevent one from doing this work. In fact, in one factory visited the operator of this type of cutting machine had for some time worked with an artificial leg. Loss of two or three fingers on one hand or defective hearing would not prove serious handicaps. The wages are about \$21 per week.

A great deal of tape is sent out in narrow strips such as one commonly sees for sale in bicycle and automobile supply stores. This tape as it comes from the spreading machine is placed on a mandrel which rests between the centers of a lathe. A tool rests on this lathe which runs the length of the fabric. The bar of the rest is notched at regular intervals according to the width of the tape desired. The operator with the assistance of the notches cuts the tape. This work must be done rapidly. The loss of a leg below the knee or of one or two fingers on one hand, hernia or slight stiffness of the trunk, or defective hearing would not prevent one from doing this work. This operation is not difficult although it would take several weeks to acquire a sufficient amount of speed. Wages are about \$22 a week.

Wrapping Narrow Tape. After the tape has been cut into the desired widths it is wrapped in tin foil to prevent drying. This is done either by hand or by an automatic wrapping machine. Most of the work is done by girls. The handicaps for this occupation would be similar to those in cutting. Girls are paid about \$12 a week. In the case of the smaller spools of tape the tape is cut and the wrapping machine operated by one man who has charge of both. His work is similar to that described in connection

with cutting the tape and the disabilities are the same. Wages are about \$20 a week.

RUBBER MATS

A great variety of rubber mats is now being made. They are used for doorstep mats, mats in automobiles, stair mats, and other similar articles. The stock for rubber mats comes from the calenders in rolls. Where a standard form is desired corrugations may be put on in the curing press. In a great number of cases, however, it is necessary to cut perforations by hand.

Slating. Before being sent to the curing press some of the rubber for mats is run through the slating machine which dusts a fine coat on the surface of the rubber. The rubber travels through this machine between rolls arranged with their axes horizontal. This work is comparatively heavy as it involves the handling of rolls of rubber. Loss of fingers or defective hearing would not be serious handicaps. Familiarity with the work could be acquired in a few weeks. The customary wage is about \$20 a week.

Cutting Perforations. After passing through the presses, which are generally very heavy, the mats are cut into the desired lengths and are ready to be perforated according to specifications. This work is done by hand. The operator lays out the work and does the cutting with the assistance of a mallet and dies. The work requires a considerable amount of skill and familiarity with the operations of measuring and ruling. Loss of fingers or hearing would not be serious handicaps. It might also be possible for the worker to use an artificial leg below the knee provided he could move around with sufficient agility. Two or three months' experience would be necessary to acquire a satisfactory familiarity with this work. The wages are about \$25 a week.

Trimming Mats. In the case of some mats the edges must be trimmed. The work is not difficult; it simply requires the manipulation of a knife. A man with one leg, the loss of one or two fingers on one hand, hernia, stiffness of joint in one ankle or defective hearing would not necessarily handicap the worker. The wages are about \$20 a week.

TRANSMISSION BELTING

Cutting Stock. Stock which is used in making transmission belting is cut into the desired widths from the rolls. The cutting is done by a series of knives arranged at desired intervals. The material is fed to these knives by a pair of rolls similar in their arrangement to the rolls on calendering machines. The operator on this machine has charge of setting the knives and seeing that the stock is being properly cut. He usually has one or two helpers who assist in the rewinding of the material after it has been cut into strips. The operator should be able-bodied, with the possible exception of loss of two or three fingers or defective hearing. One of the helpers, however, could do his work with an artificial leg below the knee, loss of two or three fingers on one hand, or defective hearing. Six weeks' experience would be necessary for an operator. A helper could learn his work in a few days. Wages for helpers are about \$19; for operators \$20 to \$25 a week.

Folding. Rubber belting is generally made of two materials, a fabric inside and a rubber cover. The fabric is folded at long tables in the required number of plies. These vary according to the quality and thickness of belt desired. The fabric is hung at one end of the table in a large roll, it is then drawn out and as it is folded it is wound on another roll at the other end of the table. Three or more men are required in this operation. The operator has general charge of the folding and it is his work to

inspect the material as it is rewound. The actual folding is done by a 'pull-over' man. In some cases a strip of rubber is laid along the joint in the fold so that during the curing process the fabric becomes practically one piece. Helpers are also required to manipulate the roll. The work of the operator is not excessively heavy. Loss of a leg below the knee, loss of two or three fingers or stiffness of knee joint in one leg would not disqualify him. In the case of the pull-over man there is a possibility that the same disabilities would apply, although the man would have to be unusually active in the use of his artificial limb to do this work. It is not excessively heavy but requires constant, moderate exertion. In the case of one of the helpers the same disabilities would apply provided some arrangement could be made to relieve him of the lifting of rolls, which at the present time he is generally expected to do. The wages for this work at present vary from \$19 to \$22 a week. The skilled operations on this work could be learned in one or two months. Where folding is done mechanically the belting is turned over by means of rolls placed at different angles on the table. Physical requirements and wages are about the same as for hand folding.

Sewing Belting. After the belting has been folded it is sewed lengthwise at regular intervals across its width. This work is done with a power machine similar to a sewing machine but heavier in construction. In some cases a single stitch is taken at a time, in other cases two stitches.

At the present time the operators of the sewing machines are both men and women. Where women are doing the work they must have a certain amount of assistance in handling the rolls of fabric. Very little knowledge is required to operate these machines beyond knowing how to wind the bobbins which the operators do

themselves. Provided arrangements could be made to assist the crippled operator with the slight amount of heavy work necessary, the loss of a leg above or below the knee, the loss of fingers on one hand, hernia, stiffness of knee or hip joints of one leg, or defective hearing would not prevent one from doing this work. The actual operation could be learned in two or three days. The wages are about \$19 a week.

Covering Belts with Rubber. After the fabric has been folded and sewed the rubber cover is put on. This rubber comes in the form of sheets which are folded over the fabric and joined along the edges. The rubber has been previously cut to approximately the size desired. This work is similar to cutting of stock for other operations. The work of folding over the cover is done by two men working together at a long table. The operator who directs their work trims off the rough edges and inspects the belting at the same time. A fourth man has charge of the lining about which the rubber has been wound as it came from the calender. The operator in this work requires a certain amount of dexterity and familiarity in trimming the edges. He should be fairly able-bodied, although the loss of two or three fingers on one hand or hernia would not seriously handicap him. What is true of the operator is also true of the men who do the folding. The helper, however, ought to be able to do his work with the loss of one leg, the loss of two or three fingers on one hand, heart trouble, hernia, certain nervous disorders, stiffness of joints in knee or hip of one leg. Arrangements could be made for this man to be seated at his work most of the time. The wages range from \$18 to \$22 a week.

Curing. The belts are cured in long presses, some of which are double deckers, accommodating twice the capacity of the single press machines. Some of these presses for curing belts are thirty or forty feet long and

fifty inches in width. What has been previously said about the operation of curing applies in this work also.

Inspection of Belts. Inspection of belts is done by two or three men working in a group, an inspector and his helpers. The chief requisite for the inspector is that he shall be thoroughly reliable and possess a fair amount of intelligence and familiarity with the material which passes through his hands. Provided his helpers were able-bodied, it is possible that he could do his work with the loss of a leg below the knee, fingers on one hand, hand or arm below the elbow. Heart trouble, hernia, certain nervous disorders, stiffness of joints in one arm or leg would not be serious handicaps. The work of the helpers is moderately heavy so that with the exception of loss of fingers on one hand the workers should be able-bodied. This work pays from \$18 to \$22 a week.

Gutta Balata Belting. Certain types of belting differ in character from those described thus far. Among these beltings are gutta balata belts, which are made and folded in a manner similar to that used in the making and folding of the canvas interior of rubber belts. The canvas, before it is folded, is treated with a balata composition. This thoroughly permeates the belting. It is folded at a long table with a heated top. The heat softens the rubber compound so that the surfaces adhere firmly to one another as they are folded together. This form of belting is not cured in an oven, but is allowed to set for a number of days under the pressure of tight winding. The qualifications and wages for making this belting are about the same as those given in the case of the making of other canvas belting.

CONVEYOR BELTING

Conveyor belting is made in a manner somewhat similar to that employed in making transmission belting

except that the finished belt is generally much wider than the transmission belting. The center of the belt is usually built up in different piles of duck with a rubber covering outside. The duck, however, is generally not sewed and the entire work is frequently done by one operator instead of breaking up the operations. These belts are cured in presses similar to those employed in the curing of transmission belting. The requirements for building up the belt are similar to those for an operator on the folding table in the making of transmission belting. The wages are also about the same.

PACKING

Packing for valves is made in two general forms, sheet and spiral. Sheet packing is a combination of rubberized fabric built up in various plies. This work is done at benches and involves the cutting and fitting together of the material. The worker should be particularly active with his hands. Loss of fingers or of a leg below the knee, heart trouble, or defective hearing would not disqualify a worker. Two or three weeks would be sufficient time for him to become familiar with his task. The wages are about \$20 a week.

Spiral packing is made by winding strips of sheet packing around a mandrel after it has been cured and giving the material an extra cure which is sufficient to set it in spiral form. This work is comparatively light and demands relatively the same physical powers as has been described for making sheet packing. The work could be learned in a week or two. The wages are about \$20 a week.

Trimming Ends of Spiral Packing. Where a sufficient amount of spiral packing is made, one man could be kept busy trimming the ends of the packing after it has come from the cure. The work requires no skill and could be done by a man who had lost a leg above or below the

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one finger on one hand, a hand or arm; heart diseases, normal or defective hearing, would also be no serious handicap. The wages are about \$18 a week.

ROLL COVERING

In connection with the manufacture of paper, large rubber rolls are used. The rubber on these rolls is built up on a metal center. These rolls vary in size, but average twelve to fifteen inches in diameter and six to eight feet in length. The rubber is built on in plies; no fabric is used in these rolls. The work is moderately heavy so that with the exception of possible loss of leg below the knee, loss of fingers, or defective hearing one should be able-bodied. Two or three months' time is required to gain full familiarity with this work. Wages range from \$20 to \$25 a week.

Grinding Surfaces on Large Rolls. After the rolls have been built and cured the rubber surface is ground down to exact size and desired smoothness. In performing this operation the roll is placed between centers of a large lathe, the tool of which carries an emery wheel for grinding. As the work of this machine usually involves assisting in handling the roll, the operator should be able-bodied with the exception of loss of fingers on one hand or defective hearing. Wages are about the same as for building rolls.

INSULATING WIRE AND CABLE

Transmission wires for electric current are generally insulated in some way, the relative tension of the current determining the thickness and character of the insulation used.

Tinning Copper Wire. Most copper wire is plated with tin before it is wound for insulation. This is done to prevent deterioration of the copper as a result of contact

with the insulating material. The tin plate is put on by running the wire from one roll through a series of vats and rewinding it at the end of the process. In the first two vats the wire passes through a solution containing muriatic acid. This cleans the wire thoroughly. In the third vat the wire passes through molten tin. By means of a cord looped over the wire, all excess of tin is removed from the wire as it leaves the vat. The fourth vat, containing water, cools the wire so that it can be rewound. The operator and his helper must keep constant watch of the process of tinning. This work is not heavy but requires constant moving about. The workers must also be able to handle the spools of copper wire as they are placed in the racks and taken down. These spools are quite heavy. Both the operator and his helper should have no more serious handicaps than loss of fingers. The operator requires three or four months experience before he is capable of taking charge of the work. His helper, however, could be trained in two or three weeks. The wages for this work range from \$19 to \$23 a week.

Rubber Tubing Insulation. After the wire has passed through the tinning process it is treated in a variety of ways according to the purpose for which it is being prepared. In the case of small wires particularly, they are covered with a thin coat of rubber. This work is done in a tubing machine and, in general, is the same as other tubing machine operations. The wire enters the machine at one side and the rubber insulation is molded on as the wire passes through a small die. In winding the insulated wire in large circular pans after leaving the tubing machine, two or three men are sometimes employed to see that the insulation is not disturbed in handling. These helpers do most of their work seated and consequently the loss of one or both legs, loss of fingers on one hand, loss of a hand or arm, stiffness of leg joints, or arm joints in one arm,

heart trouble, hernia or defective hearing would not prevent one from doing this work. The wages for the helper range from \$18 to \$20 a week.

Curing Rubber Insulation. After the insulation has been molded on the wire the large pans in which the wire is received are taken to the curing ovens. Where several of these ovens are operated together it might be possible for a disabled man to take charge of the heats, provided some arrangement could be made so that he would not have to assist in operating the doors of the vulcanizers. Disabilities and wages for this work would be the same as have already been described.

Taping Wire. After the rubber coat has been cured on the wire it is generally wound with friction tape. This work is done on a machine which revolves one or more spools of tape around the wire. In the cases of smaller sizes of wire this winding is done very rapidly. The spools move in their circular course around the wire so rapidly that the eye can scarcely follow them. One or more of these machines are in charge of a single operator. He must be fairly active as he has to handle the spools of wire. Consequently with the exception of the loss of two or three fingers on one hand or defective hearing he should be able-bodied. The work could be learned in two or three weeks. The wages are \$20 a week.

Twisting Insulated Wire. Where two insulated wires are used in such work as making telephone connections, they are twisted together. This work is done on a machine which revolves one of the wires about the other at a rapid rate. The operator on this machine would need both hands, arms, and legs, though loss of fingers or defective hearing would not seriously handicap him. The wages are about \$20 per week.

Finishing Insulated Wire. Some qualities of insulated wire after they have been wound with cambric are cov-

ered with a coat of tar. The tarring is done by drawing the wire through a vat of melted tar. The wire passes through the tar very rapidly so as not to affect the insulation, which has been previously put on. One man has charge of this operation. There is considerable moving about and lifting to do and it is impossible for the worker to keep himself entirely free from the tar. The qualifications are practically the same as those for twisting wire, as the work is fairly heavy. Two or three weeks would be sufficient time to become familiar with the work. The wage is about \$20 a week.

Polishing. After the wire has been coated with tar it is sometimes drawn through a polishing rag in order to give it a smooth surface. This work could be done by an operator who is seated, provided some arrangement could be made for handling the spools of wire. The loss of a leg, of two or three fingers on one hand, of an arm or hand, stiffness of joints in one leg or one arm, hernia, certain nervous disorders, or defective hearing, would not prevent one from doing this work. One or two weeks' time would be sufficient to learn the work. The wage is about \$18 a week.

Overhauling and Patching Wire. Before insulated wires are sent from the factory they must be tested to ascertain that there are no leaks. In the case of small wires they are run through a vat of water. By means of electrical connections the operator detects any leaks by holding one end of the circuit wire in his mouth. This work can be done seated so that the loss of one or both legs would not prevent one from engaging in this operation. As the worker not only detects the leaks in the insulation, but makes repairs, he would need the use of both hands. Providing arrangements could be made for handling the spools of wire, hernia or stiffness of trunk muscles would not be serious handicaps. The wages are \$18 to \$20 a week.

machines this operation is combined with that of twisting the cables described under the preceding heading. The qualifications for the operator and helper are practically the same as in the case of twisting. One or two months' experience would be necessary to operate either the twisting or winding machines. The wages are the same for both.

Winding Steel Tape. Where unusual strength is desired in the cable it is sometimes wound with a steel tape as well as with the other coverings already described. The tape is wound much after the fashion of the cambric tape. The requirements and wages for this work are practically the same as that for winding cambric tape.

Leading Cables. In the case of the larger cables a lead covering is placed around the cable proper. This lead cover is molded around the cable in a manner very similar to that employed in molding the rubber insulation in the tubing machine. The lead is fed into the mold from a reservoir above it. The workmen employed in leading should be able-bodied as they must handle lead ingots and do a fair amount of lifting. The operator requires three or four months' training, although his two or three helpers could learn their work in a few days. The wages for the operator are about \$25. The helpers receive \$19 or \$20 a week.

Testing. 'Punching out' is a technical term applied to testing large cables. Where the cables are expected to withstand moisture they are immersed in large tanks for a certain period of time, depending upon the purpose for which they are built. An electric current of specified voltage is then passed through the cable for a definite length of time. In this way any leakage or flaws in the cable are shown. This work requires an able-bodied man as he must be particularly active and any mistakes or mismoves on his part might result seriously. The wages are \$20 to \$25 a week.

LEATHERETTE

Although rubber does not enter into the composition of the surfacing material in the manufacture of leatherette, this material is being made by mechanical rubber concerns. The process itself is very similar to that of spreading in the manufacture of friction cloth. The basis for the surfacing composition or lacquer is cellulose which is made from celluloid waste and similar material. The lacquer is mixed in large churns for a period of from twenty-eight to forty-eight hours. The work in the mixing room is comparatively heavy and requires an active man, although the loss of fingers or defective hearing would not be a serious handicap. Two or three months' training is necessary to acquire desirable familiarity with the work. Wages are about \$20 a week.

Spreading Lacquer. From the mixing room the lacquer is taken to the spreader where it is applied to the surface of the cloth in a manner similar to that employed in rubber spreading. After the fabric has been surfaced it is run through an air chamber where it is dried with the assistance of warm air. The operator of this machine should be fairly active so that with the exception of loss of fingers, or defective hearing there will be no opening for disabled men. The helper on this work should also be fairly able-bodied. The operator could be trained in three or four weeks. The helper could pick his work up in as many days. The wages for the operator are about \$27 a week, for the helper about \$22.

Graining. Where it is desired to leave a pattern on the leatherette it is placed in a flat press as it comes from the roll. The press is left on the leatherette for a few seconds and then the material is drawn on to a section which has not been in the press. In this way the leatherette is gradually drawn from one roll to another as it passes through

the press. The work requires a fairly active man. Loss of fingers or defective hearing would not be serious handicaps. The work could be learned in three or four weeks. The wages are about \$20 a week.

Inspecting the Fabric for Knots. This work is similar in character and requirements and pay to that described under inspecting fabric for piece goods.

Inspecting Leatherette. This work in general resembles the inspection of piece goods material and involves the same disabilities. Wages are about \$20 a week.

THE FOUNDRY

Some mechanical rubber companies which manufacture a large amount of hose make their own couplings, nozzles, etc. Although this work does not belong strictly to the manufacture of rubber, it is so closely related that a brief description of the operations has been added to the discussion of mechanical rubber.

Core Making. In molding the hollow part of the nozzle or coupling, a sand core is placed in the mold in such a way that the metal, as it is poured, will surround the core. The cores are made by hand by pounding sand into a mold. As all the cores are comparatively small, the work is not heavy. At the present time, some foundries are employing girls. The entire operation can be done seated. The important feature of the work is rapid manipulation of the sand and pounding tools. In one foundry, where men were able to turn out about 700 cores apiece per day, it was found that women could increase the number to a maximum of 1,150 per day. This would tend to show that the work is more desirable for women than for men from the standpoint of the factory. The loss of one or both legs, the loss of one or two fingers on one hand, stiffness of leg joint, or defective hearing would not be serious

nically called 'sprues' or 'gates'. They are removed on a machine which operates like a punch. Two sharp chisel edges are brought together, thus cutting the sprue away. The machine is operated by a treadle. It is possible that the loss of the left leg would not prevent one from doing this work. With this exception, however, the operator should be able-bodied. The work could be learned in a comparatively short time. The wages are about \$22 per week.

Washing Castings. In order to remove the core from the castings and clean them after they are taken from the molds, they are put in tumbling barrels. These barrels are revolved so that the castings are turned around in water and brass chips. The operator sorts the castings as they come from the tumbling barrels. The work involves considerable moving about, so that with the exception of loss of two or three fingers on one hand or defective hearing the worker should be able-bodied. The wages are about \$21 a week.

Snagging or Grinding. In order to completely remove protruding parts on the castings, they are ground on emery wheels. The work could probably be done by a man who had lost a leg below the knee. Loss of fingers, or defective hearing, or hernia would also not prove serious handicaps. It is probable that arrangements could be made for the worker to be seated. Two or three months' time is required to gain familiarity and speed in grinding. The wages are about \$22 a week.

Inspecting Castings. Before the castings are sent to the finishing department, they are inspected for defects which might arise from faulty molds or cores. In many foundries this work would not take the entire time of one man throughout the year, but it is probable that similar work could be provided for him. The loss of a leg below the knee, the loss of two or three fingers on one hand,

hernia, or defective hearing would not prevent one from doing this work. The wages are from \$18 to \$22.

Pattern Making. A great many of the patterns used in making brass sundries for hose are of metal. Many pattern rooms would offer an opening for a worker who had lost a leg or two or three fingers on one hand. Heart trouble, certain nervous disorders, or defective hearing would also not prevent one from doing this work. The pattern maker receives about \$30 a week and should be able-bodied under ordinary circumstances. His helper, who would be gradually learning his duties from the time he entered the pattern shop, would receive about \$21 a week.

Summary. Although many foundries are installing fairly effective mechanical devices for drawing off undesirable fumes, this work would nevertheless be unfitted for anyone whose lungs were at all affected. The light in the foundry is apt to be unsatisfactory and the work in general is not as attractive as that in most departments of rubber manufacture.

BRASS FINISHING

Cleaning and Grinding. After the castings have been ground and inspected, they are ready to go to the finishing department. The castings are again ground on an emery wheel to obtain an even surface. Most of this would could be done seated. The loss of one leg above or below the knee, loss of two or three fingers on one hand, stiffness of joints in one leg, hernia, or defective hearing would not prevent one from doing this work. Three or four weeks would be required to gain thorough familiarity with it. The wages are \$18 or \$20 a week.

Testing Nozzles. Before being attached to the hose, all nozzles are tested under water pressure. This work could be done seated and involves the screwing of the nozzle to a

pipe and turning on the water. The loss of a leg, of two or three fingers on one hand, or possible loss of a hand, or arm below the elbow would not prevent one from doing this work. Heart trouble, hernia, certain nervous disorders, or defective hearing would also not prove serious handicaps. The operator will get his clothing wet unless he is careful, so that any one who is apt to be affected with rheumatism or similar troubles should not undertake the work. The wages are about \$15 a week.

Plating. The plating of the castings is done in large vats. This work involves a fair amount of lifting, though it is possible that a particularly active man who had lost a leg below the knee could be used. With the exception of loss of fingers or defective hearing, he should be otherwise able-bodied. Although there are few fumes from this process, it would not be advisable for any one to do this work who had any lung difficulties. Two or three weeks' time would be sufficient to gain familiarity with the operation. The wages are about \$18 a week.

Lathe Work. There is a considerable amount of lathe work in connection with the finishing of the nozzles. They must be trimmed, reamed, threaded, and drilled according to the requirements of various castings. A lathe could be operated by a man who had lost a leg below the knee. Loss of fingers or hernia would also not be serious handicaps. The loss of fingers, however, should not prevent him from an active use of his hand, as he needs both hands most of the time. The work could be learned in one or two months. The wages are about \$19.

Assembling Nozzles. After being drilled and threaded, the parts of the nozzles are assembled. This is bench work and comparatively light. The loss of one or both legs would not prevent one from doing this work, as he could be seated throughout the day. He would, however, have to be particularly active with his hands, so that possible

loss of fingers should not interfere with his handling the brass parts. The work can be learned in a few days. The wages are about \$15 a week.

MACHINE REPAIR

In the larger rubber plants a machine shop is maintained for repair work. Various operations come into a machine shop, such as lathe work, drilling, and milling. Some of this work could be done by a man with an artificial leg below the knee. Loss of two or three fingers on one hand, hernia, or defective hearing would also not seriously handicap him. His wages would range from \$19 to \$25 a week according to the amount of previous experience he had had.

TRUCK MEN

Nothing has been said in the discussion of the work of various departments about truck men. In general, the qualifications for this work are the same throughout the single plant. In some plants the moving about of material is done on hand trucks. These trucks must be loaded by hand and pulled from one part of the factory to another. This work is naturally very heavy and requires a man not only in good physical condition, but also of more than average strength.

In some factories, the work of truck men is much lighter than this, because of the introduction of special truck devices. The lifting of material on and off trucks has been done away with to a considerable extent by introducing a truck which will slip under a frame on which the goods have already been piled. By a mechanical device this frame is lifted from the ground. Instead of hand-power trucks, motor-driven trucks are being introduced, so that the exertion of pulling heavily laden trucks about the floors of plants is eliminated. Where such devices are employed, it is possible that arrangements could

be made for the operation of a motor truck by a man who had lost a leg below the knee. With the proper device he could also control the levers with the loss of a hand or arm. No great amount of knowledge is involved in the work except familiarity with the department in which the man works. Two or three weeks would be sufficient time to acquire this. The wages range from \$19 to \$21 a week.

Inspection. In connection with all mechanical rubber departments, careful inspection is made of the finished products. The department inspectors must have a general idea of the processes involved in the making of articles which pass through their hands. They must be able to detect flaws readily and they must be men in whom the head of the department has confidence, so that there will be no danger that unsatisfactory work will be allowed to pass through their hands. In most departments the work of the inspector is not heavy. In some cases the loss of a leg below the knee, the loss of two or three fingers on one hand, hernia, heart trouble, certain nervous disorders, stiffness of the trunk muscles, stiffness of knee muscles in one leg, would not prevent a man from undertaking this work. Two or three months' training and experience would be desirable preparation. The wages usually vary from \$20 to \$25.

RECEIVING AND SHIPPING

The work in these departments, with the exception of the clerical help, is extremely heavy, as it includes trucking and auto driving. A trucker could do his work with loss of fingers, loss of sight of one eye, or defective hearing. There would be an opening, also, in these departments for a clerk who had lost a hand, but who was capable, and could write with his good hand. The work could be learned in two or three weeks. His wages would be \$18 to \$20 a week.

Tires

Cutting Stock. Stock for various kinds of tires is prepared in the same general way as stock for hose. The rubber and duck are cut by hand or by machine as in hose making. The physical requirements for these operations would therefore be the same as those previously mentioned. In the case of the fabric the cutting is done in short widths on the bias, as in the case of cutting hose fabric. These strips are pieced together to make a continuous length. This work is similar also to that discussed under the making of hose.

Booking. After the rubber stock has been cut into the desired widths and lengths, it is placed on a frame between pieces of cloth to keep the strips of rubber from adhering to one another. This work is done largely by women. Although the arranging of the strips is very light work, the same operator usually handles the frames or books. The books are not extremely heavy, but are usually carried a short distance to the table where they are placed on racks. The loss of fingers on one hand, heart trouble, hernia, certain nervous disorders, or defective hearing would not prove serious handicaps. Where the carrying of books could be eliminated, the loss of a leg would not prevent one from doing this work. One or two weeks of sufficient training. The wages vary from \$19 to \$25 a week.

Winding Stock on Spools. As a matter of convenience and where casings are built by machine, the rubber and duck stock for making casings is frequently assembled on spools. The operator who assembles the stock receives 10¢ a book. The material is wound in the desired order on the metal spools. The work is comparatively light. Loss of two or three fingers on one hand, loss of a leg below the knee, stiffness of joints in one knee, heart

disease, nervous disorders, hernia, or defective hearing would not prevent one from doing this work. The wages vary from \$25 to \$30. Two weeks would be sufficient time to acquire familiarity with the work.

Making Bicycle Tires. Bicycle tires are built up by hand by combining various plies of rubber and fabric. The work is done on a drum, the diameter of which equals the inside diameter of the tire. The work in general resembles other operations where rubber is built up in plies. At the present time both men and women are engaged in making bicycle tires. The chief requirement is rapid and accurate manipulation. The loss of two or three fingers on one hand, or of one leg below the knee, stiffness of knee joint in one leg, hernia, or defective hearing would not prevent one from doing this work. Stiffness of body or arm muscles would be particularly undesirable. The operator could acquire a fair degree of efficiency in four weeks' time. This work is commonly done on a piece-work basis and at present pays from \$20 to \$30 a week.

Curing Bicycle Tires. Where bicycle tires are cured in considerable numbers, the presses are arranged in a long row. In front of them are tables where the molds are put over the tires after they have been inflated. The curing presses are cylindrical and are sunk vertically in the floor. They will generally accommodate three or four tires. Each mold is placed between separate plates of the press. This work is very heavy and hot and requires able-bodied men, though the loss of two or three fingers would not be a serious handicap. The operation of tire presses is commonly done on a piece-work basis. Four or five weeks would be sufficient time for a man to learn the work of operating the press. The wages range from \$30 to \$40 a week.

Inspection. In connection with the operation of tire presses, there is frequently a general inspector who sees

that the work progresses smoothly. While this work is not heavy, it requires a man who will insist upon a high standard of workmanship. The loss of fingers, of a hand, or of an arm, or stiffness of arm or body muscles, or hernia would not prevent one from doing this work. The wages are from \$25 to \$30.

Making Tubes. Tubes for automobile tires are commonly made without fabric. The rubber stock is cut into proper widths and lengths and folded over a mandrel. The cutting and making are sometimes done by a single operator working at a long table. Loss of two or three fingers on one hand, hernia, or defective hearing would not prevent him from doing this work. It is possible also that a particularly active man who had lost a leg below the knee could obtain a fair degree of efficiency. From four to six weeks' training would be required to learn the operation of cutting and making. This work pays from \$20 to \$25 a week.

Curing. The tubes are cured on a mandrel in a manner similar to other processes of curing.

Cementing and Splicing. It has been evident that the tube thus far has been in a single length. In order to form it into the shape of a tire, the two ends, after the tube has been removed from the mandrel, are cemented and spliced. This work at present is being done largely by women. The splicing is accomplished in the most modern method by treating the cemented joint with acid. The work is comparatively light, though it requires very rapid movement of the hands and arms. Loss of two or three fingers on one hand, loss of a leg below the knee, stiffness of one knee joint, hernia, or defective hearing would not prevent one from doing this work. Wages are about \$20 a week.

Putting in Valve. After the ends of the tube have been joined the valves are put in. This work also requires very rapid use of hands and arms. Women at the present time



Courtesy, Fisk Rubber Co., Chicopee Falls, Mass.

Making treads by hand

Behind each worker are books containing duck and rubber from which the tread is built up on the table



Courtesy, Fisk Rubber Co., Chicopee Falls, Mass.

Making inner tubes

The rubber stock is rolled on mandrels prior to curing



Courtesy, Fisk Rubber Co., Chicopee Falls, Mass.

Making casings by hand

Hand tools are used in rolling the layers of rubberized fabric and rubber strips about the core which gives form to the tire



Courtesy, Fisk Rubber Co., Chicopee Falls, Mass.

Machine method of making casings

One of the wheels for folding the material around the mold can be seen under the worker's right elbow. The stock is wound on the mold easily as the latter revolves



Courtesy, Fisk Rubber Co., Chicopee Falls, Mass.

Vulcanizing room for tire casings

Chain and belt conveyors are used for handling the heavy molds which fit into the cylindrical ovens



are generally employed for this operation. The work is done at a bench, so that loss of a leg below the knee or stiffness of the knee joint in one leg would not seriously handicap the worker. Loss of two or three fingers on one hand, hernia, or defective hearing would also not disqualify one. Two weeks' training would be sufficient time for learning the operation and acquiring a fair degree of efficiency. The wages range from \$20 to \$25 a week.

Winding Cord Tires. In the heavier casings for automobile tires, a cord base is built up in order to give added strength to the tire. This cord is wound automatically at an angle of forty-five degrees to the circumference of the tire. The casing mold is placed vertically in a machine where a mechanical device passes the cord around the mold. At the same time the mold is revolved slowly, so that the cord forms a solid cover to the mold at the completion of each winding process. The cord is usually put on in two plies, the second ply crossing the first ply at right angles. Between the plies is a covering of friction duck. One operator cares for a number of these winding machines. He should be fairly able-bodied, as the work involves the handling of the metal molds. The loss of fingers or defective hearing would not be serious handicaps. From a month to six weeks' time is required to gain desirable familiarity with the work. The wages are from \$25 to \$35 a week.

Rubberizing Tire Cord. The cord which is wound on the casing to form the cord tire is first wound on large spools. In the process of winding, the cord passes through a rubber solution and from that to a long curing box where the solution is vulcanized into the cord. In this way the cord is rubberized by the time it reaches the winding spool. One operator has charge of a number of these machines and must in general be active with his hands and legs. Loss of one or two fingers or defective hearing would

not seriously handicap him. The work could be learned in three or four weeks' time. The wages range from \$25 to \$30 a week.

Building Tire Casings (Hand). In the case of cord tires, as well as those which are not wound, the different plies of the casing are put on either by hand or by machinery. The work in both cases is comparatively heavy, as it involves the handling of the molds on which the casing is built. The work of building up the plies by hand is similar in principle to that involved in the making of bicycle tires. The entire operation of building the casing is carried on by one person. At the present time most of the work is being done by men, though in some cases women are proving successful when properly selected. The work itself, besides being heavy, requires rapid movement of hands and arms. In most factories the material is so placed as to eliminate almost entirely movement about the floor, though the work could not be done seated. The loss of two or three fingers on one hand or defective hearing are about the only disabilities which would not disqualify the worker. From four to six weeks are required to gain a desirable degree of proficiency in making casings. The wages range from \$20 to \$35 a week.

Building Tire Casings (Machine). When the plies of casings are built up by machine, two or three of the inside plies are usually rolled on the mold by hand before it goes to the machine. At the machine the rubber and duck plies are hung on spools. The casing mold is arranged so as to revolve in a vertical plane. The operator fixes the end of the ply to the mold and revolves it. When the mold has been covered for its entire circumference, a mechanical device consisting of two disks folds back the material over the surface of the casing. The requirements and wages for this work are practically the same as those for hand building.

Making Treads and Beads. Hand-made treads are built up from plies of duck and rubber much as casings are built, except that the work is laid out flat on a table. The disabilities and training are the same as for building bicycle tires. The salary is from \$20 to \$25 per week. Heavy tire treads are commonly made on a machine similar in its general construction to a tubing machine. In some machines the tread, as it comes through the die, is in the form of a tube. Just as it leaves the machine, there is a slitting knife which opens the tube and the tread comes out flat. This machine, which is somewhat larger than the ordinary tubing machine, requires one operator, one or two men to feed it, and two or three helpers who cut the tread in desired lengths and place it in books. Beads are made on a similar machine. The operator of a tread machine could do his work with the loss of a leg below the knee, stiffness of joints in one knee, hernia, or defective hearing. It is possible that where there are two feeders and two or three helpers, one feeder and one helper might have the same disabilities. The time required to learn the work on this machine is practically the same as for tubing machines. Wages range from \$25 to \$35 a week.

Curing Treads. In some factories treads are semi-cured before they are put on the casings, while in others the treads and casings are cured together after the tire has been made. In the case of semi-curing treads, the tread is placed on a metal drum which carries the negative of the impression desired in the tread. The semi-curing is done in a curing oven similar to that used for curing tires. The requirements and wages are practically the same.

Making Cord Tire Water Bags. In the curing of cord casings the casing is filled with a water bag similar in construction to the inner tube. This bag is filled with water so that the desired amount of expansion is obtained during the curing processes. The water bags are built on

mandrels in a manner similar to that employed in the building of tubes. They have, however, a rubber center and several plies of duck over it. The work involves rapid use of the hands and arms. At the present time both men and women are engaged in this operation. If arrangements could be made for placing the stock at the worker's table so that he would not have to walk to racks for it, the work could be done by a man who had lost a leg below the knee or whose knee joints were stiff. The loss of one or two fingers, hernia, or defective hearing would also not seriously handicap the worker. From two to three weeks' time would be sufficient for gaining necessary familiarity with the work. The wages vary from \$25 to \$35 a week.

Making Cord Tire Water Bags. (Minor Operations.) In connection with the making of water bags there are a number of minor operations. One of these is the making of the water bag flap which goes around the water bag and fastens into the mold. It is made of friction duck. The physical requirements are practically the same as those for making the water bags. The wages vary from \$20 to \$25 a week. Before the flaps are placed in the casings they are painted. This is done by hand with a brush. The requirements here are about the same as those previously mentioned for making the flaps. The wages are about \$20 a week. Two or three weeks would be sufficient time for acquiring familiarity with the minor operations in building water bags.

Curing Casings. Where the tread is semi-cured before putting it on the casing, the casing is also semi-cured. Instead of putting the casing into an outside mold, it is frequently wound with duck while in the inside mold. This work is done by machinery which revolves the tire and at the same time winds it. The work is comparatively heavy, as it involves the handling of the casing and

mold so that the operator should be able-bodied with the exception of defective hearing or loss of two or three fingers on one hand. The wages are \$20 to \$25 a week. Where the casing and tread are cured together they are placed between an inner and an outer mold. Most of the operations in the curing of casings involve heavy work. In the larger curing rooms the vulcanizers are arranged in rows and are conveniently near various mechanical devices which assist in handling the molds. With the assistance of endless chain and belt devices, the lifting and moving about of the molds by hand can be practically eliminated. However, even with the assistance of mechanical devices the men require all their physical powers. The work is hot and heavy. One operation, however, in this department could be carried on by a man with certain disabilities by standardizing the work. The heats in the various curing chambers could be placed in charge of one operator. The loss of a hand or arm below the elbow, the loss of a leg below the knee, stiffness of elbow or shoulder joints in one arm, the loss of fingers, or hernia would not be serious handicaps in this work. The wages are about \$25 a week.

Cleaning and Inspecting. The rough edges must be taken off tire casings before they are ready to be sent from the plant. This is done at a buffing wheel. The work is comparatively heavy. Loss of a leg below the knee, or of two or three fingers on one hand, or defective hearing would not seriously handicap the worker. The wages range from \$20 to \$25 a week.

Wrapping Casings. Anyone who is familiar with automobile tires as they pass through the hands of the retailer, knows that they are wrapped with paper which comes in long strips and is wound in a spiral around the casing. The mechanical device, by which this wrapping is put on, is very similar to that by which the cord is put on cord tires. The operator could do this work with the

loss of two or three fingers on one hand, stiffness of joints in one knee, or defective hearing. One or two weeks' experience is sufficient to learn the work. The wages range from \$20 to \$30 a week.

Making Solid Tires. Solid tires are made of rubber which is wound around a metal frame parallel to the circumference. In some cases the rubber is wound directly from the calender and thus eliminates the work of re-handling. The operator must handle the completed tire, so that his work is comparatively heavy. With the exception of loss of two or three fingers on one hand, or defective hearing, the worker should be able-bodied. Five or six weeks are sufficient to gain familiarity with the work. Wages are about \$25 a week.

Another method for making solid tires which will probably gain popularity involves the use of a machine similar to that employed in making treads. The rubber portion of the tire is turned out complete in strips which then are placed on a drum and cured.

TIRE REPAIR

Defective tubes and casings are repaired wherever possible. This work is done at benches and consists of removing the defect and putting in a patch. As some of the casings are heavy, the workman should be able-bodied, unless arrangements could be made for one or two men to repair the lighter casings and tubes. In this case, the loss of a leg below the knee, the loss of two or three fingers, or defective hearing would not be serious handicaps. The work could be learned in a month or six weeks. Wages are \$18 or \$20 a week.

TIRE SUNDRIES

Making Emergency Patches. This work consists of cutting and putting together in various plies friction duck



and rubber. The work is done at tables, one operator doing the cutting and piecing together. Girls usually do this work. Arrangements could be made for a man who had lost a leg to sit for the entire operation. Loss of two or three fingers on one hand, heart trouble, hernia, or stiffness of leg joints, or defective hearing would not seriously handicap him. The work could be learned in a week or two. The wages are about \$18 or \$19 a week.

Curing Patches and Other Sundries. Patches are cured in press molds arranged in a series of ten or a dozen molds to a press. The work is similar to other press work and the operator ought to be able-bodied with the exception of loss of two or three fingers or defective hearing. The wages range from \$20 to \$25 a week. There are other curing operations of a somewhat lighter character in connection with the vulcanizing other tire accessories.

Boxing. Patches and tire accessories are commonly put up in cardboard boxes. This work involves rapid movement of the hands and arms and, in general, resembles the boxing of larger rubbers previously described.

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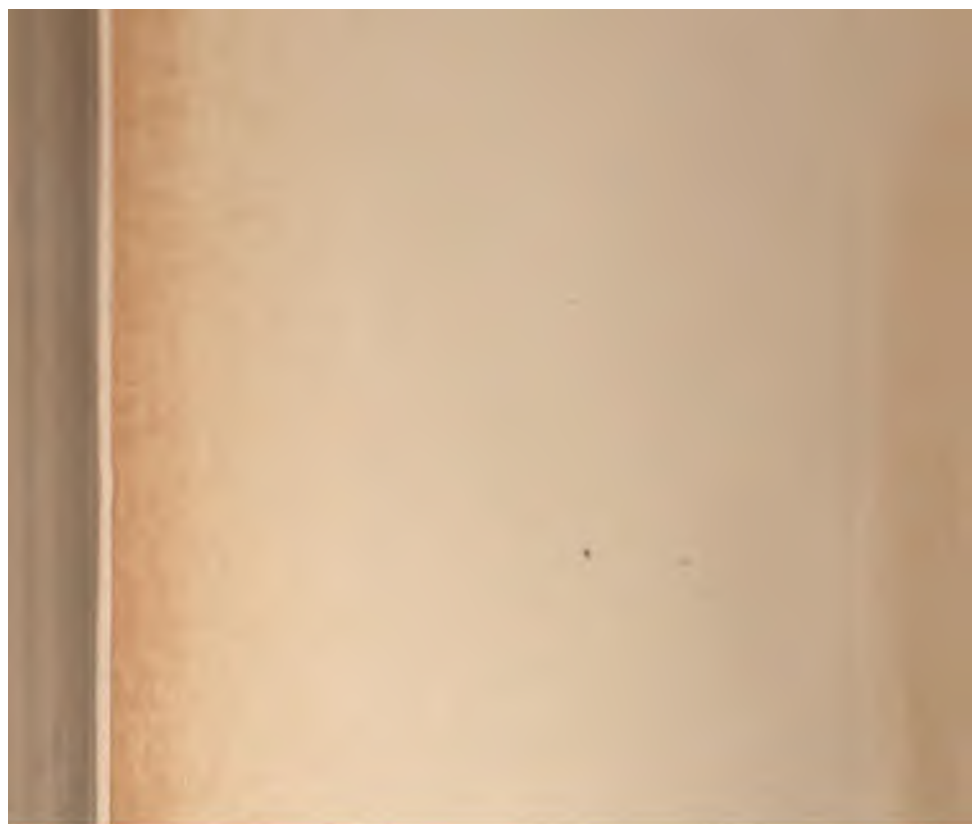
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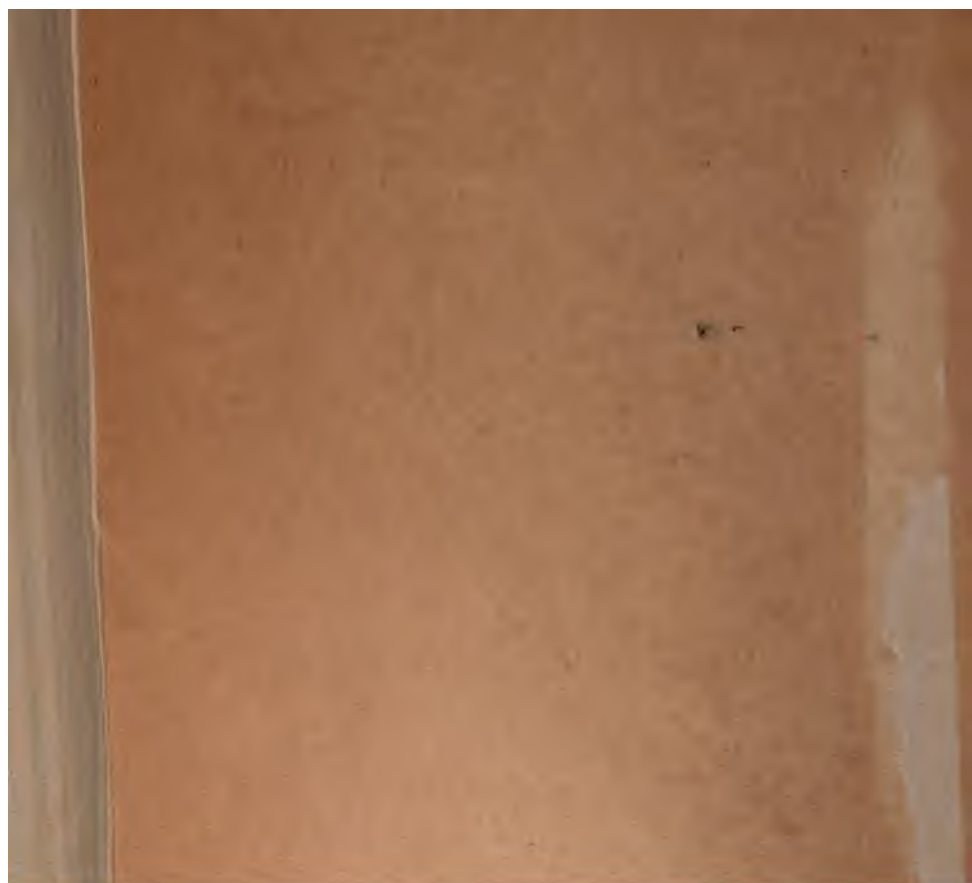
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